Climate Adaptation and Local Narratives: Using qualitative inquiry to inform adaptive management on the North Shore of Lake Superior Minnesota, USA

A Thesis

SUBMITTED TO THE FACULTY OF
THE UNIVERSITY OF MINNESOTA

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS

FOR THE DEGREE OF
MASTER OF SCIENCE

Advisor: Mae A. Davenport

February, 2018

Acknowledgements

First and foremost, I would like to express my deepest gratitude to my advisor and mentor, Mae Davenport. Her guidance, encouragement, and complementary sense of humor have been instrumental to my growth as a researcher and my success in graduate school.

I would like to thank my committee members, Kristen Nelson and Susan Galatowitsch, for their guidance through this process. Their patience and insight have been invaluable in the development of my thesis.

This study would not have been possible without the dedicated team working on the Community Climate Readiness Project. The commitment to quality, community focused research by the professors, students, and staff on that project was an inspiration. Particular thanks is due to Dr. Erin Seekamp and Dr. Allie McCreary of North Carolina State University. I would also like to recognize the project funders, Minnesota SeaGrant, for their commitment to community engaged research and willingness to tackle the topic of climate change.

Additionally, I owe a debt of gratitude to all of the participants in this research project. I strove to do justice to their words and experiences. I hope that the project made a difference in their community, and that this work continues to foster resilience on North Shore.

I would like to give a huge thank you to the other students in the Davenport Lab. No graduate student is an island, and many bright minds and friendly faces have passed through the lab during my time here to whom I owe thanks. Additionally, I would be remiss if I did not offer a special shout out to the maddog squad – Vanessa Perry, Joe Nowak, and Holly Meier – for their support, humor, and comradery through good times and bad.

Finally, I cannot express enough my gratitude to my family. To Jess, my partner in all things, for always believing in me and traveling halfway across the country to see this through – I could not have done this without her. To my family and friends back home for supporting my madcap plan to move to Minnesota. And a special thank you to my Mom for her unwavering support and endless wisdom which has been a rock during trying times.

Abstract

Adaptive approaches to local climate change impacts primarily focus on finding the best fit between the scale of ecological systems and the scale of existing management systems. This paper argues that a third scale, the scale at which the community perceives the problem of climate change, is essential to constructing best-fit management practices. To understand community perceptions, qualitative interviews of key stakeholders on the North Shore of Lake Superior, Minnesota were collected. Analysis of the interviews was developed into a narrative visualization framework, providing local decision makers with climate narratives in an accessible format. The narrative frameworks detailed convergence around the attribution of changes in forest health and wildlife populations to climate change, but divergence around when to be concerned for local impacts. Findings indicate the need to ground local adaptation in observable changes, and the importance of facilitating stakeholder engagement with the range of narratives present in the community.

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Chapter One: Project Background and Study Introduction

The North Shore of Lake Superior in Northeastern Minnesota is a natural resource tourism-dependent community that relies on the quality, accessibility, and consistency of the regions natural spaces for economic viability. Heavily trafficked in summer and winter, the North Shore experiences seasonal swings in economic activity and resource use, with downhill and cross country snow sports in winter giving way to forest and lake-based summer outdoor activities. Over the course of a single year, as many as 5.76 million people visit the region, creating more than $1 billion in travel related expenditures. This economic activity directly supports 25,000 full time equivalent jobs (Davidson-Peterson Associates, 2008). Local communities' reliance on these jobs, as well as on the funds raised through taxes on hotel accommodations, cannot be overstated. Despite the desirability of the region for recreation, trends in recent years have seen a decline in visitation (MN DNR, 2004). Any changes to local lands and waters that negatively impact the desirability of the region for recreation and tourism activities, has the potential to severely disrupt the economic viability of the region.

Climate change is poised to produce negative impacts to the North Shore, with current impacts already effecting the region. Changing seasonal weather patterns, increased occurrences of extreme weather events, increasing fire danger, and disruptions to local plant and animal communities are all currently documented in the region (Galatowitsch et

al., 2009; Huff & Thomas, 2014; Lenarz et al., 2009). These changes not only produce a degraded recreation environment, but also increase the sense of risk and uncertainty around travel to the region. Concern for fires or extreme precipitation events in the summer months, and uncertainty around snow and temperature conditions in the winter, can result in visitors making recreation choices that are closer to home or to sites with less uncertain conditions (de Freitas, 2003).

To address current and future impacts, local leaders will have to define the problem of local climate change, identify stakeholders, and construct a decision-making process. The management of complex environmental problems is moving towards adaptive structures and strategies, those that are inclusive, flexible, and proactive. Adaptive approaches draw heavily on the work of economist Elinor Ostrom and her work with polycentric governance. Ostrom (2010) describes the potential for multiple actors working at different scales to produce cumulative large-scale impacts and produce systems that are innovative, resilient, and inclusive. These polycentric approaches require engaging diverse actors including informal local leaders and institutional actors (Ostrom, 2010). Recognizing that each group of decision makers is unique, and that climate change impacts vary based on the local built and natural systems, demands the creation of unique governance arrangements and management strategies (Ostrom et al., 2007). Managing climate change means not only managing natural resources, but also managing the people dependent upon, and making decisions about, those resources.

To confront climate change impacts and work towards a more resilient North Shore, community leaders need a better understanding of what changes are coming to the region, how local managers understand those changes, how visitors will respond, and what capacities the region has to adapt. This study sought to address each of these needs. A research partnership between the University of Minnesota, North Carolina State University, and Carleton College was formed to provide the necessary expertise. The project's specific objectives were to:

1. Assess capacity to adapt to climate change in nature-based and tourism-dependent communities on the north shore of Lake Superior.

2. Compile and synthesize climate-hydrologic data to perform impact modeling using temperature and precipitation probabilities, means and variability to develop destination risk scenarios.

3. Administer a recreation/tourism visitor survey in select north shore summer and winter destinations to evaluate beliefs and behaviors associated with climate-related environmental change.

4. Compile and synthesize economic-tourism/recreation data to perform response modeling and develop destination risk scenarios.

5. Develop, integrate and deliver decision-support tools for adaptive planning in capacity- building workshops with local planners,

managers, and decision makers and through additional resources available on the Internet.

This project worked to identify which climate related changes and impacts to natural systems will most effect north shore visitation and assessed the current capacities of north shore communities to adapt to current and future changes. The combination of local climate models, onsite visitor surveys, and economic trend analysis provided local decision makers with crucial, localized information on what changes to expect both in local ecosystems and the potential shifts in visitation patterns and tourism revenue that relies on those ecosystems.

While local models and trend data are crucial for sound, proactive decision making around climate change impacts, understanding the capacity of local communities to make changes and implement policies is equally important. Capitalizing on existing community strengths and bolstering community weaknesses necessitates a nuanced understanding of the beliefs, behaviors, and interpersonal structures present in the community. For example, having an active and engaged citizenry would require a different approach to adaptive capacity than a community with less active citizens but strong, proactive institutions. The duration of this paper focuses on the social science aspects of the project, specifically better understanding the capacity of local decision makers to address the current and future impacts of climate change in the region.

The assessment of North Shore communities' capacity to adapt to climate change, in a highly nature-based recreation-dependent economy,

was preformed using qualitative social science methods. Researchers conducted twenty-five in-depth semi structured interviews and three focus groups with local elected officials, natural resource managers, business owners, and community activists. Qualitative analysis procedures were used to identify community narratives of change as well as themes around community capacities, and decision maker beliefs and perspectives.

The goal of the qualitative social science portion of this project was to assess the capacity of local communities to adapt to a changing climate and address local impacts. The remainder of this paper focuses on the role of change narratives on management capacity and the challenges of problem definition when addressing the complex issue of climate change. Specifically, this study focuses on the following research goals:

1. Determine how decision makers on the North Shore define the problem of climate change, with particular attention paid to the spatial and temporal scale of climate change impacts.

2. Analyze how decision makers perceive local environmental changes, and relate those shifts to climate change.

3. Investigate community decision maker narratives of climate change, including the development of a narrative visualization framework.

4. Assess the usefulness of narrative analysis for management in the framing of adaptive approaches to climate change management.

The study goals are to localize the definition of climate change, give validity to local experiences of change, and producing a nuanced understanding of the range of climate narratives held by community decision makers. The study provides the community with an improved understanding of how local decision makers perceive climate change, define the boundaries of the problem, and new insight into the narratives of climate change present in the community. These outcomes offer opportunities for new management narratives to be constructed which will better mobilize the community through reflecting the communities own beliefs and experiences of change.

This thesis is comprised of three chapters: (1) project background and study introduction, (2) study findings from interviews with North Shore decision makers, and (3) discussion.

Chapter two is presented as a standalone manuscript, intended to be submitted to a peer-reviewed journal for publication. The manuscript examines decision maker narratives of change to determine how leaders on the North Shore define the problem of climate change, with particular attention paid to the spatial and temporal scale of climate change impacts and perceptions of environmental changes associated with a changing climate. Additionally, the development and design of a narrative visualization framework is presented, and potential applications discussed. Twenty-five semi-structured interviews were conducted with local elected officials, natural resource managers, tourism business owners, and community activists. Through analysis of these interviews, climate

narratives emerged. Additional analysis of the narrative components and structure were used to produce the narrative visualization framework.

Chapter Two: Climate Adaptation and Local Narratives: Using Qualitative Inquiry to Inform Adaptive Management on the North Shore of Lake Superior Minnesota, USA

Introduction

Complex problems, those without clear points of origin or clear paths to resolution, require new approaches to decision making, management, and governance. Climate change is a complex phenomenon that is difficult to characterize at the local scale, the scale at which proactive and reactive management decision are often made. No singular strategy for local management exist, as each location faces different climate impacts due to regional ecological characteristics and the structure of the local community and built environment (Mimura et al., 2014). Managing climate change impacts at the local level requires each region to develop its own strategies, starting with defining the scope of the problem of climate change within a local context.

The challenges to effectively and efficiently managing climate change at a local level begins there, in the phase of problem definition. Defining the problem requires setting the scale of the problem, a scale that is the best fit between current and predicted ecological impacts, the scope of existing management institutions, and climate change as it is experienced by the local community. The ecological scale can be determined using maps and models, and the institutional scale discerned through analysis of jurisdictions, agency mission statements, and public

mandates. However, the third layer, the scale of the problem as perceived by the community, is harder to determine. What is needed, and what this paper seeks to provide, is a method to visualize and map the ways in which community members experience and understand the problem of climate change at the local level. This critical piece in the process of defining the scale at which to address local climate change can then be used to construct management approaches that resonate with local citizens and managers, build political support for adaptive practices, and strengthen individual motivation to take action within the community.

Historically, finding the appropriate scale at which to confront an environmental problem has been a top down process, with a focus on biophysical elements and existing governance boundaries and structures (Chaffin et al., 2014). Climate change, however, is a global phenomenon with vast implications for interconnected biophysical systems. Adaptive approaches – policies and actions undertaken to retain the function of systems in the face of current and future changes – acknowledges the multi-scalar and interconnected nature of natural and social systems (Nelson et al. 2007). The recognition of multi-scalar systems includes an acknowledgment of local scale climate impacts which necessitates not only new types of action, but a new narrative of climate change as a local problem that threatens local systems. Establishing a proper "fit" for environmental governance of climate impacts at a local scale requires more than networking institutions to match an ecosystem scale, it must take into account the community's identity and needs.

Local climate change and the management of local impacts does not seek to address the cause of climate change or limit the emission of greenhouse gasses. Instead, local scale management of climate change deals with the ecological and social impacts that a changing climate has on a community. Degradation of key economic resources, stresses on critical infrastructure, impacts to the natural landscape leading to a loss of the community's identity or sense of place, are all potential consequences of climate change felt at a local level. Building local support for local scale climate change management actions requires inclusive, constructive dialogue.

Presently, adaptive governance is recognized as a flexible and proactive approach to complex environmental problems like climate change. Adaptive governance is governance framework that is characterized by the inclusion of diverse stakeholders, multi-scalar networked actors and institutions, and flexible policies (Olsson et al., 2004). Further, adaptive governance acknowledges that as systems change, interdependent systems must change as well in order to remain resilient. (Folke et al., 2005). However, adaptive approaches need a formalized method for understanding the scale at which locals experience problems. It is not enough to network actors and create new institutional approaches to address institutionally defined problems. The community needs to be included in the definition phase (Paschon & Ison, 2014).

To ensure active individual participation in addressing climate change impacts, the scale of the problem, and the scale of problem governance, must be meaningful to the community. Humans construct

meaning, not through facts, but through experiences. Climate change is a phenomenon that frequently defies the human capacities of perception (Blennow et al., 2012). The same issues of scale that make climate change difficult to confront with existing governance approaches – temporal and spatial – make climate change difficult for individuals in a community to experience, or realize that they are experiencing. Increasingly, scientific fact alone is not enough to persuade individuals to take action; values, beliefs, and situational characteristics interact with knowledge to affect actions (Lorenzoni & Pidgeon, 2006). Without contextualized meaning - observable experience – the facts lack resonance, and find limited motivational purchase.

Narrative is one of the ways that humans make sense of complex problems. Narrative at the individual scale gives context, linearity, meaning to human life (Veland & Lynch, 2017) and function to contextualize and explain external issues and events (Stapleton & Wilson, 2017). Narrative analysis is an opportunity to understand the meaning that community members give to the changes happening around them. Narratives are situated in place, they are contextual, rich, and act as a mediator between fact and meaning. While adaptive governance offers an opportunity to define the problem and construct an appropriate scale of management, without an understanding of community narratives of change, it is likely to reproduce existing institutional narratives. Collecting community narratives serves to validate local knowledge and experiences, while simultaneously reengaging community members with the changes confronting their lives and livelihoods. Community narratives, when analyzed, offer insight into community members' beliefs, values, and

concerns. These insights can support a reframing process that forms new narratives inclusive of different beliefs and experiences (Jerneck, 2013). Managers can then use these insights to bound the problem of climate change, fit a network of formal and informal institutions to that defined scale, and construct relevant communication aimed at motivating community members. Narratives, however, are slippery. Internally inconsistent, varied across individuals, and informed by external discourse, narratives are also cumbersome and complex (Stapleton & Wilson, 2017). The component parts of a narrative, the relevant pieces, can be difficult to parse, and the narrative as a whole difficult to visually represent.

This paper seeks to construct a tool to visualize narratives of climate change in a way that is accessible for local decision makers and usable to inform the construction of a management narrative complementary to those existent in the community. Qualitative interviews were conducted with decision makers on the North Shore of Lake Superior in Northeastern Minnesota. The study area is an emblematic natural resource recreation dependent community, with a history of extractive industry giving way to a booming tourism economy. Climate change is shifting the makeup of local ecosystems, producing unpredictable seasonal conditions, and disrupting expectations of visitors and residents alike. A grounded theory approach was used to analyze the interviews, followed by an in-depth narrative analysis focused on climate change beliefs and perceptions (Charmaz, 2006). From this narrative analysis a visualization tool was built to represent individual narratives. Viewing individual narratives provides decision makers – local elected officials,

natural resource managers, business owners, and informal community leaders – with insight into the internal inconsistences and points of connection and disconnection held within individual narratives. When viewed as a series of narratives, the tool provides the ability to see the range of narratives present in their community and the areas of convergence, divergence, and conflict. With these narratives in hand, a group of community members – whether associated with formal institutions or not – looking to promote adaptation to climate change can begin the work of constructing a narrative of local climate change that values local experience, produces meaning at a scale salient to community members, and has the potential to motivate individuals to act.

Literature Review

Finding the right scale at which to define problems and govern effectively is crucial to confronting complex environmental problems. Determining the "fit" between governance and social-ecological systems across spatial, temporal or functional scales has been linked with successful management outcomes (Moss & Newig, 2010; Pittman et al., 2015). Transboundary and multi-jurisdictional environmental problems challenge managers and community leaders to find ways to overcome governmental or bureaucratic boundaries in order to develop an effective and efficient strategy to manage environmental problems. In part because the scale at which a problem is constructed by those experiencing the effects may differ from the scale of the decision making bodies attempting to manage them, both in spatial distribution and the distribution of political power (Adger et al., 2005; Lebel et al., 2005). The process of politicizing scale can produce disconnects between the scale of those making

management decisions and the scale of those impacted by those decisions (Abrams et al., 2015; Adger et al., 2005; Lebel et al., 2005).

Top down approaches to managing complex environmental problems often prove ineffective and inefficient. Command and control approaches can alienate local stakeholders, and the interventionist role of the "expert" is becoming increasingly suspect (Dietz et al., 2003). Duplication of similar efforts by different sectors, inefficient distribution of resources, and poor communication with community members are all failures of top down structures addressing complex environmental problems. Adaptive approaches are those that can operate under uncertainty and include a higher level of stakeholder engagement, and are the oft-cited alternative to top down approaches (Chaffin et al., 2014).

Adaptive approaches require strong community support and the inclusion of diverse community voices. This need for inclusiveness can consist of bringing diverse stakeholders into the dialogue around the management of a particular resource (Dietz et al. 2003), developing processes of more in-depth participatory engagement (Karpouzoglou et al. 2016), and making strides to overcome what Paschen and Ison (2014) term the "illusion of inclusion" by giving local knowledge equal standing in the governance structure. A number of authors on the subject of adaptive governance express a need to expand beyond the standard accepted framing of learning and knowledge and provide opportunities for traditional ecological knowledge, local expertise, and personal experience to be incorporated into the objectivist scientific understanding of the environmental problem or resource to be managed. (Boyd & Folke, 2012;

Chaffin et al., 2014; Paschen & Ison, 2014; Wyborn, 2015). This need for a more radical form of inclusiveness further primes narrative for a more active role in defining environmental problems.

At the most fundamental level, narrative is the form and content present in the telling of an experience and includes at least two points in time (Jones & Song, 2014; Lejano et al., 2013; Shenhav, 2014; Stapleton & Wilson, 2017). Using this definition, any description of change is an example of narrative. Theorists describe narrative as a process by which change is contextualized, given meaning, and converted into a form that is easier to understand and remember (Costabile, 2016; Stapleton & Wilson, 2017; Veland & Lynch, 2017). Understanding the narratives present in a community is not the whole picture. Similar to the complexity of environmental problems, narrative theory also operates at diverse scales and are subject to political pressures.

Commonly, narratives are generated from a culturally appropriate list of all possible alternatives present in "variants of culture's canonical forms" (Stapleton & Wilson, 2017). Miller's (2000) canonization theory furthers that conception, and posits that new narratives are built form the foundational understandings present in existing narratives. Miller positions narrative as emergent from larger frames born from historically informed institutional positions. This process then reinforces existing power structures, and refutes local narratives that may arise from different experiences or positionalities. Narratives informed by institutionally established frames are often at odds with both what communities experience in terms of impacts, but also with how communities view their

own capacities and life histories. To ensure the proper fit of adaptive strategies, effected individuals need the ability and opportunity to see their stories of risk and vulnerability reflected in management approaches (Miller & Solin, 2015).

A singular climate change narrative will not effectively reach all audiences or reflect all values and experiences. Climate narratives need to incorporate multiple voices, particularly vulnerable populations and those currently experiencing impacts (Farbotko & Lazrus, 2012). “Climate is changing, but its meanings are contingent on place and history and cannot be imposed from above without risk of disjuncture and injustices” (Farbotko & Lazrus, 2012). Furthermore, narratives based on direct experiences embed individuals as actors in the ‘story’ of change going on around them (Miller & Solin, 2015).

The study of narratives often draws distinction between individual narratives and collective narratives. At both scales, narrative is a sense making tool, providing explanation and contextualization to external issues and events (Costabile 2016; Stapleton & Wilson, 2016). At an individual level, narratives can also function as a decision making tool, operating as a predictive model, drawing on personal pasts and the narratives of others making similar decisions, to tie unknowns to knowns in order to confront uncertainty. When an external event or issue challenges that narrative, defies the contextualization or linearity of the individual narrative, either the narrative shifts, or the individual denies the existence of the event or issue (Veland & Lynch, 2017). This offers an explanation for both the phenomena of psychological distancing of complex problems and the

outright denial of personal observations of the impacts of complex problems.

Research into community perceptions of climate change is a relatively new. As climate change preparedness begins to focus more on community level adaptation and climate change risk assessment, the need to understand how community members perceive climate change and local risks and impacts moves to the forefront. Stakeholder perceptions are a crucial aspect to understanding and reducing climate change vulnerability at the community level (Trawöger, 2014). These perceptions inform local and regional policy proposals and influence decision makers (Halder et al., 2012; Schmidt et al., 2011; Trawöger, 2014) and analysis of these climate change perspectives can provide a means of increasing the integration of local knowledge with scientific understanding (Halder et al., 2012; Schmidt et al., 2011).

There is little consistency in the way that researchers are approaching the study of climate change perspectives, even within qualitative methodologies. In qualitative inquiries into climate change perceptions, researchers work towards a deep and contextual understanding of how individuals in a community perceive climate change. The common thread within the climate change perception literature is the efforts made towards understanding local concerns, and how they are constructed. Meli (2015) defined climate change perceptions as the changes the research participants noticed. Meli's (2015) analytic approach was to look for points of shared perceived change across the social groups in the region in order to facilitate collective decision-making and

overcome social or positional differences. Others have chosen to compare community members' perception of current climatic conditions with instrumentally recorded historical data (Howe & Leiserowitz, 2013), include elements of discourse analysis to understand power dynamics in climate perspectives (Granderson, 2014), and use qualitative approaches to understand how the social and environmental processes interrelate (Geisler et al., 2016).

Despite these different approaches to the use and understanding of climate change perspectives, two common themes emerged. First, the disconnect between community members' recognition of climate change as a global issue, and the recognition of, and concern for, local impacts (Granderson, 2014; Trawöger, 2014). This psychological distance, while not unique to climate change, is symptomatic of the uncoupled nature of the threat. As Jasanoff (2010) illustrated:

> Climate, moreover, is spatially unbounded. It is everywhere and nowhere, hence not easily accessible to imaginations rooted in specific places. And, unlike the weather, climate change occurs over spans of time that are not easily assimilated to circadian or seasonal rhythms: it is not perceptible nor provable as a day or year of human life shades into the next.

The difficulty in tying climate change to a specific location challenges the ability of local citizens to prioritize adaptive action or vulnerability reduction over other more readily imagined threats. The second theme that emerged is the influence of current weather trends on belief in the existence or severity of climate change. Individuals in a region experiencing average temperatures and weather patterns tended to not

see climate change as a threat. (Howe & Leiserowitz, 2013; Trawöger, 2014). The tendency to conflate weather with climate, and use average years as a justification for inaction, is a challenge to garnering community public support and engagement around climate change adaptation and risk prevention. Understanding how community members perceive climate change is an essential step in the process of community level management of climate change impacts.

Complex environmental problems defy the scale and scope of pre-existing management programs and governance arrangements. Adaptive approaches to addressing such problems necessitates an inclusive approach that centers local conceptions of the problem and concerns for the future. Narrative provides both a process through which individuals and communities contextualize and rationalize the changes they experience as well as a data set for analyzing those local conceptions of environmental problems.

Methods

Selected as an emblematic natural resource based tourism community, the study area of the North Shore region of Lake Superior in Minnesota is a rural, heavily forested area rich in recreation opportunities (Bitsura-Meszaros et al., 2015). The North Shore region has a robust recreation economy in both winter and summer. The winter season tends to bring heavy snows, and recreationists are active on the downhill ski slopes and expansive cross-country skiing, snowshoeing, and ATV trails. Summer sees an active lake culture, hikers and backpackers, scenic drivers and wildlife viewers, as well as visitors attracted to the cooler

temperatures due to what has been termed the “air conditioner” effect of Lake Superior.

The North Shore study area (Appendix A) is defined by the North and South Superior watershed boundaries, which includes parts of two counties – Lake and Cook County – as well as 189 miles of Lake Superior shoreline (Bitsura-Meszaros et al, 2015). Lake county, the southern of the two counties, has a land area of 2,109.29 square miles and a population of 10,631 (2010 census).

The economy in Lake and Cook Counties is heavily dependent on visitation. Between June 2007 and May 2008, 5.76 million individuals traveled to the region, and contributed more than $1 billion in travel-related expenditures. This supported the equivalent of 25,000 full time jobs. (Davidson-Peterson Associates, 2008). The large areas of public land are an essential driver of the North Shore region’s economy, with two-thirds of visitors participating in active recreation (Davidson-Peterson Associates, 2008). With so much public land, the tax revenue in the region relies heavily on the “bed tax” levied on hotel rooms, a further dependence on visitation for the vitality of the community. In 2008 taxes on accommodations in Cook County produced over $1 million dollars in revenue, totaling 26.25% of the total taxes collected (Minnesota Department of Revenue).

Research conducted in the state of Minnesota provides predictions of environmental change at differing levels of specificity. Galatowitsch et al. (2009) present predicted changes at the biome scale across the state.

The predicted changes at this scale include the loss of boreal forest under high emissions scenarios, and the loss of numerous tree species including the culturally significant paper birch. These changes are driven in part by the increase in temperature and decrease in average annual precipitation across the biome, but also as a result of the related increases in forest fire, blowdowns, and the spread of pest species (Galatowitsch et al., 2009). A substantial decline in the moose population of Northern Minnesota over the last decade has been attributed to climate change and pathogens and malnutrition (Lenarz et al., 2009). Models show the moose population in the state continuing to decline as climate related heat stress and habitat loss continue to increase (Lenarz et al., 2009).

Changes to average weather temperatures and precipitation patterns are also predicted for the North Shore region. According to a Lake Superior Climate Change Impacts and Adaptation prepared for the Lake Superior Lakewide Action and Management Plan - Superior Work Group, annual average temperatures are projected to increase 5 to 7 °F and winter average temperatures are projected to increase 9 °F by 2050-2060 relative to 1979-2011 ranges. In addition to overall increases in annual temperature, precipitation patterns are changing, with more precipitation falling as rain in the winter, and less overall precipitation in the summer months. Additionally, ice cover on Lake Superior will continue to decrease, lake wind speeds will likely increase, and the growing season will extend (Huff and Thomas, 2014). Warmer air temperatures are predicted to have a negative impact on tree survival, and combined with changing precipitation patterns will likely negatively impact local plant and wildlife populations. Increasing lake temperatures will support the

expansion of aquatic invasive species, and likely result in the transition of fish populations to those that can tolerate higher water temperatures. (Huff & Thomas, 2014) Changes to weather, snow and ice cover, forest health and distributions, and wildlife populations, have economic as well as ecological implications due to the high dependence on natural resource based tourism (Smith et al., 2016).

The study used a qualitative methodology to data collection and analysis. Hour long semi-structured qualitative interviews were conducted with local decision makers in the North Shore study area. For the purposes of this project decision makers included local elected officials, park managers, state and federal land managers, and tourism professionals. The high percentage of public land and the heavy economic dependence on natural resource based tourism drove the decision to focus on stakeholders from larger government institutions and in the business sector.

Table 1 Interview Demographics

		N
Gender	Male	14
	Female	12
Age	Median	55
	Minimum	32
	Maximum	71
Years lived in community	Median	24
	Minimum	5
	Maximum	56
Formal education	Did not finish high school	-
	Completed high school	2
	Some college but no degree	3
	Associate or vocational degree	2

College bachelor's degree	12
Some college graduate work	-
Completed graduate degree (MS or PhD)	2

The interviews were conducted in person at locations convenient for the interview participant, all but one participant consented to the researchers recording the interviews. Recorded interviews were transcribed, and the unrecorded interview was summarized through extensive real-time note taking. In total, 24 interviews were audio-recorded, in accordance with qualitative research protocol for reaching theoretical saturation (Creswell, 2013). An initial list of stakeholders was brainstormed in conjunction with local partners, and additional participants were recruited using a snowball sampling technique.

A qualitative narrative approach garnered hours of audio-recordings and hundreds of pages of transcribed text. The analysis of this large data set was conducted using NVivo 11 Software (NVivo qualitative data analysis Software; QSR International Pty Ltd. Version 11, 2016). Initial analysis was conducted using a grounded theory framework, and an open coding process (Charmaz, 2006; Strauss and Corbin, 1997). Grounded theory posits that imposing an external framework on the data in the initial stages of analysis constricts the data and limits the findings via preconceptions and research expectation. Instead, grounded theory allows the data to speak for itself, and important themes and concepts to emerge without external pressures. The analysis was triangulated through a process of inter-coder reliability with three researchers analyzing the data through an open coding process (Garrison et al., 2006). The check-

ins allowed for points of confusion with the data to be discussed, and areas of differing interpretation to be debated and occasionally resolved.

Secondary analysis took place in two iterative phases. After the initial open coding analysis, it became apparent that emergent themes relating to climate change were coalescing around issues of spatial and temporal scale, distancing, and diverse identification of what local changes were associated with climate change, or may be in the future. These emergent themes necessitated a return to the literature to better understand current research being done into local climate change perspectives. This literature review, reflected in the ideas presented in early sections of this paper, went on to inform a secondary analysis focusing on the community member perceptions of the scale and threat of climate change on the North Shore.

Inter-coder reliability and an ongoing dialogue between analysis and literature are two of the ways in which the credibility of the analysis is established. To increase the credibility of the study, researchers during the coding process focused on using the participants own words to define the broader categories, ensuring that the categories are broad and cover a range of experiences, and checking for strong logical links between participants' words and the broader analysis (Charmaz, 2014). The essential test of study credibility is whether or not the analysis reflects the participants', researchers', and readers' experience of the study subject (Corbin & Straus, 2015). Corbin and Straus (2015) also point to the time intensity required for credible qualitative research. Here that time is represented in the multiple rounds of interview coding, memo writing, and inter-coder reliability meetings for each phase of analysis. Both the

findings and the resulting narrative framework were tested by returning to the data to ensure accurate representation and fit between what is presented here and participants own words.

Findings

To determine how decision makers on the North Shore define the problem of climate change, this study sought to determine how climate change was perceived, what local impacts were associated with climate change, and how understanding community narratives of climate change could benefit local adaptive approaches to climate change management. Through analysis of interviews with elected officials, natural resource managers, business owners, and community activists, themes around climate change and local impacts were parsed. The theme of scale emerged in three areas: the spatial scale of the problem, the temporal scale of the problem, and the scale of governance actors and institutions believe to be responsible for addressing the problem. Each of these three themes of scale will be discussed below.

Climate change beliefs and spatial scale

Common media and political narratives often emphasize both the "global" and the "warming" aspects of climate change. The views of many local decision makers reflect this narrative framing. For some participants, the global nature of the problem was a cause for distancing, a problem for other countries and world leaders, not for the relatively few residents of the remote North Shore. As one participant said,

> A little warming trend wouldn't be bad. I realize it would be very bad for California. I just feel lucky to be up here; in

> many ways I feel like we are in a bubble. We have the naivety about the rest of the world, like, "We are Cook County. We are fine.

For others, the global nature of the problem was a cause for concern, and a rallying cry for local sustainability or self-reliance. Moving away from fossil fuels, focusing on food security and a resilient local economy were described as win-win benefits for addressing a global problem locally, regardless of whether or not those individuals attributed local impacts to climate change. As one participant stated,

> I think the benefits of countering climate change are all beneficial. We should just do that anyway because what is the worst-case scenario: 'Oh, we have more solar. Oh, more independence' I'm working really hard to not really educate or complain about climate change, but trying to build the infrastructure underneath it. I'm trying to get solar. I'm trying to get wind. I'm trying to increase organic matter in my soil.

There were also decision makers that drew connections between changes observed on the North Shore and global climate change. Descriptions of declining moose populations, the recession of trees typically found in the northern forests, and increased wildfire danger, were commonly cited impacts decision makers tied to climate change. As one participant described,

> The birch decline, that is a big thing, the whole forest with climate change. I think with climate change the shore is losing some tree species.

Many participants, after describing beliefs and opinions about climate change and associated local impacts, expressed uncertainty about their statements and observations. Phrases ending with "I don't know,"

"Nobody really knows," and "It might be cyclical" were common among interviewees who did and those who did not associated observed changes with climate change.

Many participants expressed uncertainty about conditions and impacts, stating a need for more information and localized scenarios. One participant who depends on snowy winters for economic stability expressed frustration with existing data:

> The information on climate change has been so regional that I have seen. By regional I mean like a blob over the entire Midwest, and then kind of a line with some other very general things like hotter weather. It's just so non-specific, what do you do with that information?

While these participants were open to having concerns about climate change in the future, they felt dissatisfied with the scale and specificity of existing information about predicted future changes.

Decision makers as a group expressed a variety of viewpoints and observations about climate change and local impacts. Descriptions of concern covered various scales, from concern for global changes, for impacts to specific animal species, and concern for the health of local ecosystems.

Climate change beliefs and temporal scale

When asked about their concerns for climate change impacts, participants expressed concern at a range of time scales, from the present, to increased urgency in the near term, to concern for impacts in the distant future.

Among decision makers who expressed concern for local impacts of climate change in the present, many predicted that their sense of concern and urgency would increase in the future. For some, the concern for accelerated change in the future was abstract, and for others concern for the life and livelihoods of the next generation motivated their increased concern for future impacts. One decision maker expressed concern for future climate impacts and accelerated change from the viewpoint of a parent: “Probably the thing that scares me the most is, of course I wonder about my lifetime, but you know, I have a little girl, and you want to be hopeful for her life.” While others had more abstract concerns:

> It’s not like we’re going to be underwater. We’re not going to see that kind of catastrophe. We’re going to see things that are more subtle and longer term; you know the disappearance of certain species […] They’re going to have big effects and it will be obvious, but it might not be obvious for 50 years.

In addition to abstraction and distancing, a theme of disbelief emerged in conversation with some decision makers. Within this theme, participants described the recent occurrence of a particularly cold winter, the natural cycles of the planet, and the fluctuations of weather throughout lived and recorded history as the source of their skepticism about a changing climate. One participant expressed skepticism towards the need to be concerned now, saying,

> This area used to be under a mile ice a long, long time ago and before that there was no ice and there was ice again, so the planet changes over time. Climates are going to change; weather is going to change. Weather patterns are going to change over time.

Themes of uncertainty around when changes would take place as well as current trends existing as part of a larger natural cycle also emerged in descriptions of potential future impacts.

Climate change and local impacts

Most decision makers, regardless of the spatial scale of their belief in climate change, noted local changes that they associated with climate change. This was often at odds with their explicitly stated scale of concern. One participant doubted that climate change would have a large impact on the North Shore, while also pointing to the potential climate cause of the declining moose population, an economically important species. This participant stated: “Slow increases in the average temperature are not going to have a severe impact up here.”

At another point in the interview, the same participant noted,

> One of the things we’re seeing up here, and they haven’t quite figured out yet, is the moose populations seem to be dying off… and I think that might be part of the climate change, that maybe their range is moving further north.

Other interviewees made similar statements. These statements followed a pattern of explicit denial of climate change occurring locally coupled with a statement expressing concern for local changes and attributing them to climate change followed by an uncertainty clause.

Local changes attributed to climate change fell into three main categories: concern for ecosystem changes, concern for weather-based changes, and potentially beneficial changes. Decision makers expressed

concern for local ecological changes including “birch decline”, “moose population decline”, “more ticks”, and “the changing forests.”

Other local impacts decision makers associated with climate change focused on weather changes. Participants expressed concern for “unstable weather”, “warmer waters”, and that “snow conditions are changing” and “if summers are hotter and drier, that creates more fire risk.”

Some decision makers noted that changes could potentially benefit the region, citing fewer days below zero degrees and hotter summers in the southern part of the state driving increased North Shore recreation.

Among those participants who did not describe current changes as caused by climate change, some expressed concern for future impacts of climate change. The areas of future concern described by these individuals were the same as those concerns their peers currently associated with climate change.

Climate change action and scale

The North Shore, like many rural natural resource dependent communities, is situated at the intersection of multiple scales of governance. Federal, state, and local institutions all play a role in managing land and infrastructure. Participants described a range of actors responsible for addressing natural resource changes on the North shore, primarily focusing on each of these three scales of governance actors.

Federal and state agencies have a large presence in the management of local forests and lands. Many decision makers who participated in this study spoke of the strong role of the US Forest Service and Minnesota Department of Natural Resources in setting policy and enforcing environmental regulations:

> I think the DNR does a very good job. They get criticized a lot but they're doing their job. I think the Department of Agriculture is doing a good job on those things. The US Forest Service brings an awful lot of resource to bear on [environmental problems].

State and federal governments hold a large percentage of land in the study area. Some decision makers described the state and federal governments land holdings as the root of their responsibility to manage natural resource problems on the North Shore. As one participant described it,

> The federal government owns 70% of the county and the state government owns most of the rest of that. So, the natural resource issues as it relates to all of that would be the responsibility of the federal, state owners.

Other participants described the percentage of public land as a challenge for local government units. One interviewee described the relationship between public land and a limited tax base for local governments:

> Amazingly, 90% of Cook County is public land. If you can't guess, that makes it very hard to run the government in Cook County because the tax base is really low.

In addition to limited financial resources, some participants described local government units as limited in the size and scope of what they were able to accomplish:

> The community is very small, and it does not have significant institutions. With 5,000 people you have a county governor or a city governor that have limited capability to do more than just the basic functions of that government. This size of the community doesn't have the capability to delve into specifically large issues like climate.

Other participants described local government units as active in addressing issues related to natural resources. As one participant pointed out, even though state and federal agencies have high efficacy and a record of success, they are not necessarily in touch with the interests and needs of community members. Partnerships with local government units and community groups were described as the necessary response to this disconnect in governance scale:

> Community groups and local governments bring a connection and a knowledge of community interests that is distinct from what the Forest Service knows about. The Forest Service I think doesn't necessarily bring to that conversation because we manage the land. And we provide opportunities through the management of the land. But we are not involved with the communities in the way that those groups are.

Collaboration emerged as a theme when describing many scales of governance and the role of governing actors. Some participants pointed to past collaborative projects as a model for success, and others described a need for more collaboration, specifically around strategic visioning at the local level. As one participant stated,

> I feel like the government structure here is rather fragmented. There isn't a whole lot of collaboration to really have a solid vision and mission for the future**.**

Application: A tool for narrative analysis

Designing a Tool for Narrative Visualization

Narrative analysis provides nuanced and detailed findings from individuals in a community. While these findings cannot be generalized to a larger population, they present the range of beliefs present in the community, and provide deep insight into the values and beliefs of the participants. Values and beliefs, which underpin our internal narratives, can be targeted to catalyze action and bolster motivation for change. The challenge lies in presenting the findings in a format that is useful and efficient for managers and decision makers. Looking for themes in aggregated narrative data, as called for in grounded theory analysis, loses the information contained in the connective tissue in a single, individual narrative.

Narratives do not necessarily follow a linear or logical path. A belief in climate change and a concern for its effects, are not necessarily followed in an individual narrative with a declared need to take action. To achieve the goal of motivating behavior change or support for collective action it is imperative to understand the points of contradiction and tension held by an individual. Mapping out the component parts of an individual's narrative brings to light those contradictions, and provides managers with a clearer understanding of what areas may be most easily leveraged for change.

Providing a visualization tools constructed from the components of local narratives gives managers the ability to quickly grasp the narratives of climate change present in the community, compare the narratives of different individuals, and understand the common points of tension without getting lost in the details. Due to the challenges of scale presented by climate change, the visualization of climate narratives also provides a road map to understanding where community decision makers stand on the scale of climate change and thus which scale of climate change adaptation might garner support.

In this case, the narrative visualization tool was built through rounds of analysis, allowing the essential components of narrative to emerge from the data. The categories and the range of possible responses were drawn from the participant interviews, rather than superimposed by the researchers. This serves not only to provide internal validity for the narrative components, but also avoids institutional bias and hierarchical power structures that might influence what defines a climate narrative. A return to the literature then served to refine these categories and provide theoretical and cross-case legitimacy. Therefore, the visualization tool follows the same thematic breakdown as the findings, but provides an easily accessible format for displaying the narratives.

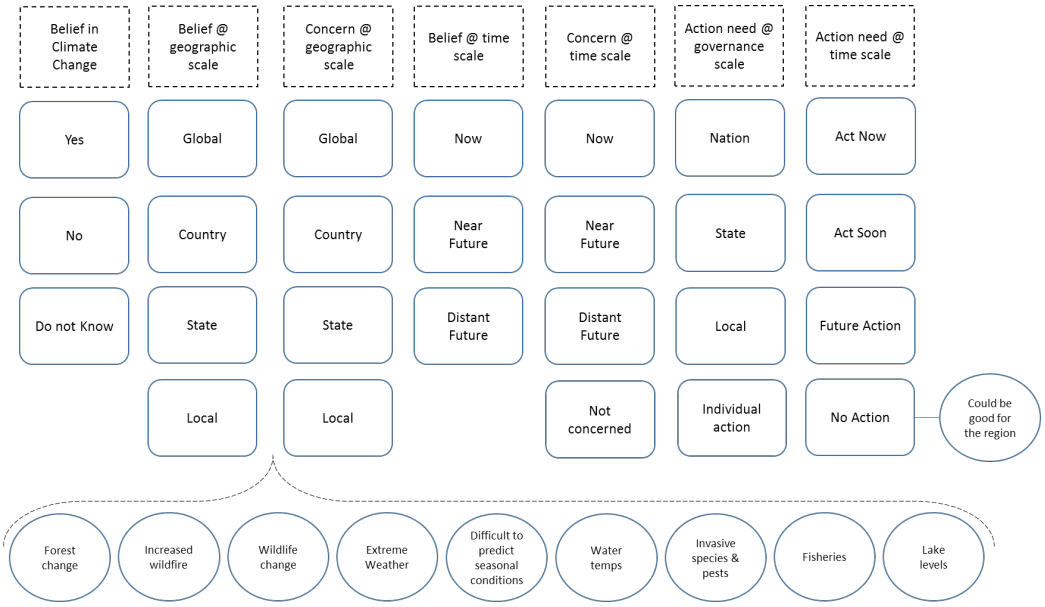

Figure 1 Narrative visualization tool

The tool highlights the biophysical and temporal scale of climate change expressed as relevant by the participant, as well as specific local areas of concern, and the physical and temporal scale of response. Due to the complex and layered nature of narrative, the tool design allows for the display of contradictions, multiple scales of relevance, and uncertainties.

Visualizing Narratives

A populated version of the tool, Figure 2, depicts a relatively linear climate change narrative. The participant expressed belief in climate change, belief and concern that it is happening locally, belief that it is happening now, and concern for impacts in the near future. They described support for both state level, and individual action, to take place in the near-term. They further expressed concern for local forest change, and local changes in water temperatures.

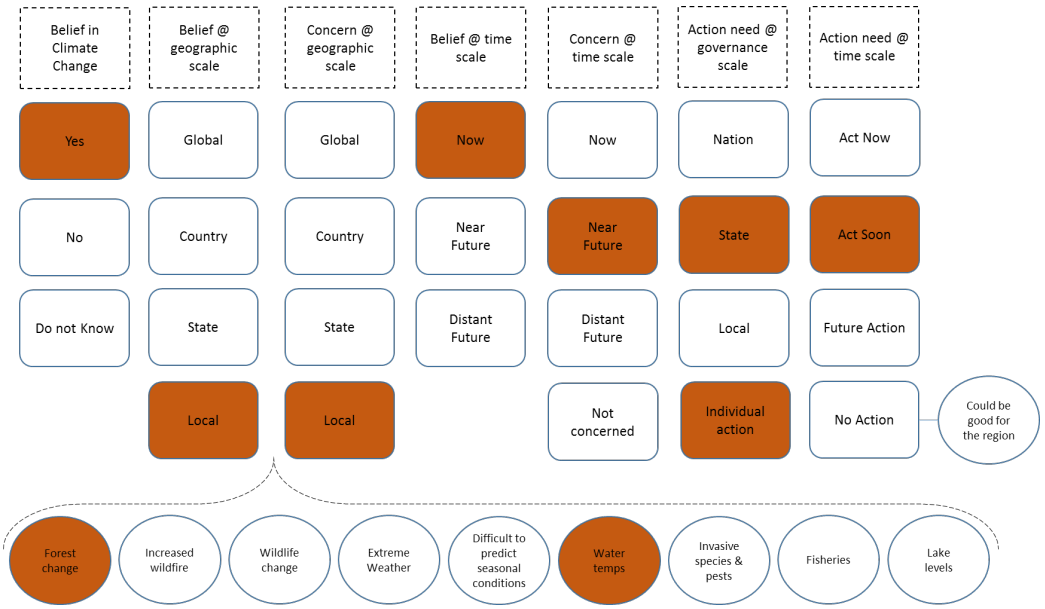

Figure 2 Narrative Visualization Tool: a linear example #1

The shaded squares reflect the analysis done on the open ended questions; beliefs extracted and ordered into a format usable by someone not familiar with the interview transcription or theoretical underpinnings. The participant did not verbally travel from category to category, but through analysis, a visualize distillation of the narrative can be created.

In the example visualized in Figure 2, the participant's narrative is one likely to be activated by a management narrative that centers local impacts causally associated with climate change. A community full of individuals with this climate narrative could be expected to accept pro-active climate change policy initiatives or take personal action to prepare or adapt to current or predicted impacts. However, with environmental problems as biophysically complex and politically charged as climate

change, competing narratives – both across individuals, and within a single individual – is a more probable scenario. Figure 3, for example, displays the equally linear narrative from an opposing position of belief and concern. The individual expressed a disbelief in climate change, a corresponding lack of concern, and no need to take action at any scale.

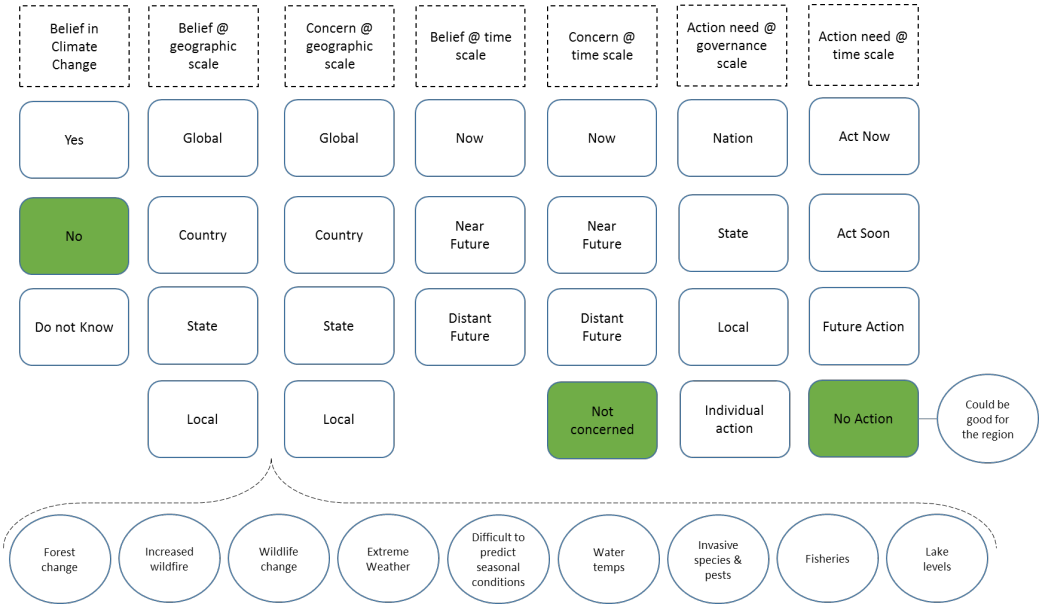

Figure 3 Narrative Visualization Tool - linear example #2

The narratives with internal contradictions present both challenges and opportunities to constructing a resonant management narrative of local climate change adaptation. While some contradictions highlight the strong commitment to local independence, others illuminate the psychological distancing and the power of uncertainty in preventing action in even the most concerned. Figure 4 illustrates a narrative centering local and present action, even though it is at odds with the participant's view that climate change is a global, not a local problem. This narrative is an example of a decision maker ready to act on climate change regardless of their belief in an immanent local threat.

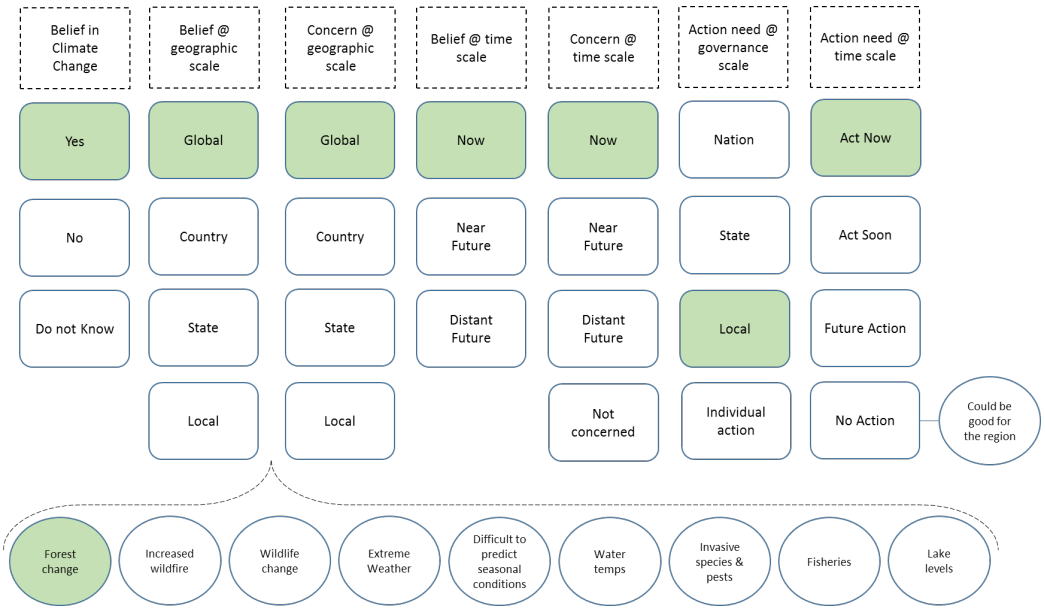

Figure 4 Narrative Visualization Tool - non-linear example #1

Conversely, Figure 5 presents a narrative with internal contradiction that would likely inhibit support for pro-active, adaptive action. Here, the participant believes in local impacts of climate change, is concerned for them, and believes they are happening now, and will worsen in the near future. They express a need for action at all scales of governance, including individual action, but push the need for that action into the future. This narrative of climate change, despite its current and localized concern, does not translate to current action.

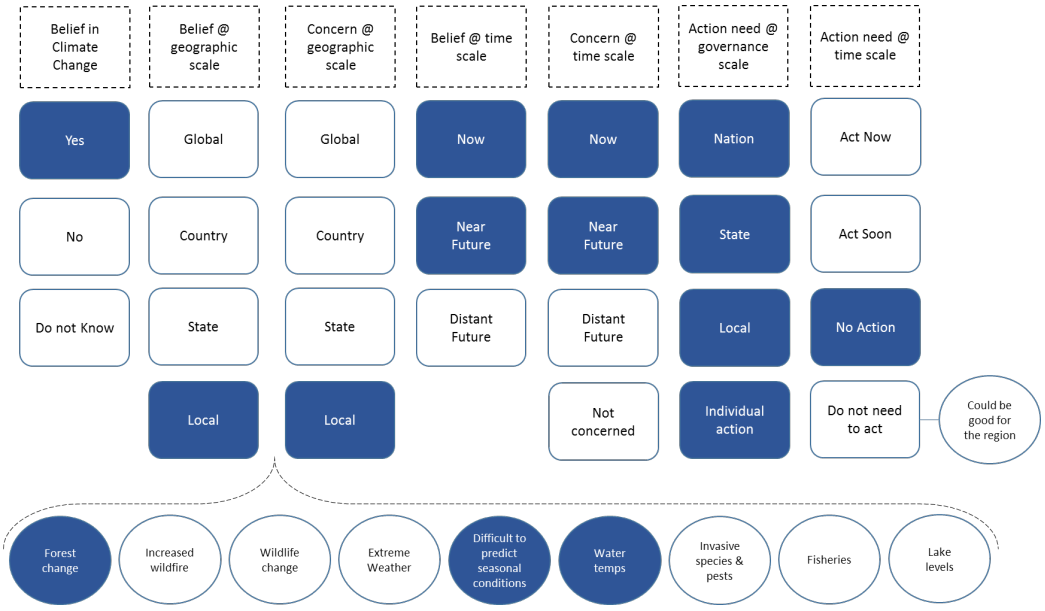

Figure 5 Narrative Visualization Tool - non-linear example #2

These four examples exhibit visually the nuance of narrative, highlighting the connections and contradictions held both within a single narrative, and across a community of decision makers. Through visualizing data in this way, managers attempting to attain a broad base of community support are better able to quickly comprehend the areas of common concern and the areas of narrative disconnect that may be limiting engagement and adaptive action. While it is tempting to layer the individual narratives to visualize a community narrative, this should only be done with specific aims in mind.

The nature of narratives is such that each narrative is inherently exclusive of all others. With this in mind, overlaying individual narratives to construct a community narrative fails to understand the role and power of the individual narrative. It also obscures the connections and contradictions the individual framework was designed to maintain.

However, the benefit of an aggregate viewing of these individual narratives is the ability to easily visualize the areas of greatest overlap (Figure 6). Illuminating the areas of collectively held beliefs and areas of concern, provides insight into what components of a new narrative of change and adaptation might prove the most useful to managers or governance networks.

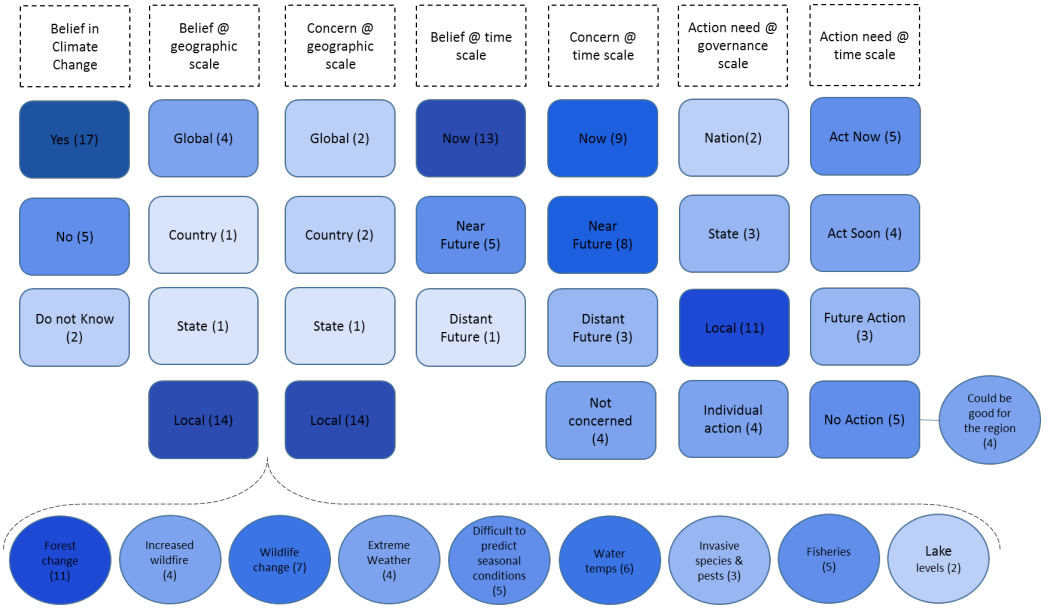

Figure 6 Narrative Visualization Tool - aggregate narratives

In Figure 6, individual narratives have been overlaid to produce an aggregate image of community narratives, with darker shading indicating areas of overlap. Viewing the data in this way is an opportunity to quickly pull out that participants have high levels of belief in climate change at the current time scale and concern for local forest impacts. However, decision makers share less cohesion around a general concern for local impacts and the timeframe in which action should be taken to address climate change. While this is a helpful shorthand for the community's narrative of

climate change, caution must be exercised to prevent assumptions of linear connections from one point of high collectivity to another, as that is another fallacy of simplification.

Interpreting a Series of Visual Narratives

Using the narrative visualization tool to examine individual decision maker's climate change narratives highlighted the range of narratives present in the North Shore community. Through side by side comparisons of the populated visualization frameworks, patterns in beliefs, concerns, connections and contradictions were deduced. Individual narratives did not always follow a linear pattern from belief to concern to action, on either side of a general belief in climate change. Additionally, concern in the present for impacts in the present, did not always linearly translate to a need for action in the present. These gaps in narrative linearity are sticking points, the places where a linear narrative of management and adaptive action will likely fail to motivate change across North Shore decision makers.

Regardless of belief, and regardless of the relative linearity of individuals' narratives, concern for tangible climate change impacts existed in almost all climate change narratives. These impacts, forest change, wildlife change, and changing water temperatures, are the easiest to recognize through lived experience and can be used to focus management narratives to the scale relevant to decision makers.

While this area of convergence is a fruitful place to begin constructing a narrative of management, two areas of divergence around

timescale will likely inhibit proactive management approaches. Decision makers expressed concern for climate change impacts at a wide range of timescales, from concern in the present, to not being concerned at all. Additionally, they described a need to act at a wide range of timescales, with decision maker narratives evenly distributed between the need to act now, act soon, act in the future, and feeling no need to act. This divergence in time scale is a significant barrier to enacting adaptive change in the present and viewing the narratives individually tells us that there is not always a direct correlation between a concern for wildlife, a concern for climate impacts in the present, and a need to act now. With this in mind, the barriers to motivating decision makers to act is not inherently a matter of working to align their narratives into a linear, causal pathway.

Conducting analysis of narratives using this framework tool provides an opportunity for the decision makers to approach each other with more sensitivity. Anonymity allows for truthful descriptions of climate change beliefs and concerns, while sharing the narratives within the community of decision makers helps to overcome the cognitive biases of "everyone thinks what I think" or "no one thinks what I think." Engaging with the nuanced and complex beliefs held by this community of decision makers allows for increased sensitivity to others' positions, and ideally the ability to anticipate and address potential points of friction more easily.

Among those complex beliefs, the narratives depict broad concern for changes in forest ecosystems and loss of wildlife. Starting a conversation about climate change by focusing on these areas of concern

rather than from a concern for climate change broadly, will help ground the discussion and decision making that follows in the local context, centering tangible solutions to tangible problems. Meaning is made from experiences, not from facts alone, and momentum will be built best through adaptive solutions that address impacts being experienced now, with outcomes that can be felt in the near term.

A dual approach to narrative – honoring the connections and contradictions within the individual, while looking for areas of overlap in the collective – is an opportunity for managers to gather insight into how local decision makers view the scale of the spatially ambiguous problem of climate change, and understand the temporal influences on the urgency of response.

Conclusion

Despite being commonly coded as global in scope, local actors will need to address local impacts whether larger government institutions are involved or not. The challenge of confronting climate change at the local scale starts with defining what that scale is in terms of both the impacts addressed as well as the people and institutions responsible for managing climate impacts. To effectively define that scale, and initiate a management response that will be seen as legitimate by the community, local actors need to be involved. Modeling and expertise alone is not enough to construct a scale of local climate change that will resonate with the community, engage local institutions, and motivate citizens and leaders to take action.

Individuals experience climate change through observing the world around them, observations which are contextualized through experiences, life and community histories, and external influences, to produce meaning. Personal narratives tell the story of an individual's process of embedding facts to produce meaning, and often how meaning informs actions, beliefs, or behaviors. Better understanding the range of personal narratives present in a community gives managers and community leaders crucial insight into the way that facts and meaning interrelate, and points of leverage to construct new meaning or ways of using meaning to better communicate management goals.

The goal of deconstructing narratives and seeking insight into community beliefs is to ascertain points of leverage that can be used to motivate changes in behavior, build support for policies, and encourage collective actions, that help the community adapt to climate change. A common response to seeing inconsistent narratives or conflicting beliefs is to propose increased education on the topic of climate change and local impacts. However, previous studies on community climate change beliefs present strong evidence that providing information on climate change is not sufficient to motivate behavior change (Bulkeley, 2000; Wolf & Moser, 2011). A claim that is supported by narrative theory, which posits that it is easier for an individual to reject a piece of information that conflicts with their narrative than it is to shift their narrative to contextualize that piece of information (Segal, 2017). Motivating individuals to take adaptive actions and support adaptive management goes beyond a focus on climate change as objective fact, and using facts to motivate adaptive actions. Telling community members to act now based on the outputs of a

computer model, when their personal narratives focus on slow changes that will be dealt with in the future, will be met with a rejection of the facts that conflict with their narrative. If, instead, community members are presented with material that reflects their lived experiences and areas of concern, their narratives will be validated and the material will be internalized and integrated.

On the North Shore, participants lived experiences pointed to local impacts attributed to climate change even when stated belief contradicted the reality of local climate impacts. This point of tension – between denying that climate change is happening on the North Shore and describing specific changes to local ecosystems as being attributed to climate change – is one example of a leverage point, where internal narratives are shifting to contextualize lived experience. Constructing a management narrative that emphasizes local impacts that are currently occurring and easily observable has the potential to motivate individuals who deny local climate change broadly by focusing on specific areas of concern. For the North Shore, forest change, wildlife decline, and invasive species all have implications for both residents' quality of life and local economic stability. Focusing community members on these changes that they are both concerned for and that they can directly experience, through senses and memory, gives meaning to their observations and motivates action more effectively than the fact of change alone.

Visualizing climate narratives illuminated the challenge of motivating present action on climate change in North Shore communities. North Shore decision makers exhibited relatively high convergence around

belief in climate change, concern for local scale impacts, and desire for action to be taken at the local scale. However, the largest area of divergence was around when to take action. Through the use of the narrative visualization framework, it is apparent that this unwillingness to take action, or the uncertainty about when to take action, is not only tied to those who do not see climate change as an imminent and local threat, but also to those who do. An additional challenge for community leaders seeking to motivate adaptive action and collaboration is to move people towards the current time scale in regards to action. Understanding that belief in current, local impacts does not necessarily correlate to belief in current, local responses, again moves beyond the need for education on climate change and instead points to a need to embedded a management narrative with tangible actions that address the observable local impacts.

Narrative analysis offers an opportunity for decision makers to include local knowledge and validate local perspectives from the beginning. Rather than relying on existing, institutional narratives of management and change, narrative analysis brings the range of narratives present in the community to light. For communities facing complex environmental problems, this process of visualizing and interpreting narratives gives the meaning derived from contextual experience equal standing with the scientifically derived fact. Meaning is the motivator, fact alone cannot push humanity forward. A group of community members – whether associated with formal institutions or not – looking to promote adaptation to climate change could construct an adaptation narrative touching on each of the themes in the narrative visualization tool and use

that to inform goal setting, communication and outreach strategies, and further collection of local experiences that support the new narrative.

Chapter Three: Problem Definition and Management Scale - A Tripartite Approach

Climate change is one of the most complex, far-reaching problems facing the world today. Not solely an environmental problem, climate change stands to impact communities and geographies around the globe, with implications for human health, economic viability, and resilient ecological functioning. The severity of climate change impacts are dependent on decisions both necessarily global and inherently local. Global collective agreements addressing how to manage and protect the common pool resource of earth's atmosphere, financial pacts between nations to support nations facing climate change impacts, and the collaboration amongst the international brain trust developing technological and policy solutions are all broad scale examples of cooperative management to address global elements of climate change. The entrenched complexity of climate change does not rest solely in the challenges of brokering international agreements; the burgeoning recognition that climate change is already causing problems on the ground, in diverse communities and geographies around the world, presents new challenges to preparing for and confronting climate change impacts.

Climate change impacts manifest differently at each location through variation in ecological functions, built infrastructure, and the interconnectivity of social-ecological systems. Similarly, the best approaches to management will vary by location. Variation in emergent impacts, variation in institutional actors, as well as the types of values, beliefs, and concerns present in the community all combine to create a

unique management landscape. To construct management approaches to address local climate change, community decision makers require knowledge of both the ecological and social systems under stress as well as the institutions in place that might address the current and future local impacts of a changing climate. These two systems – the systems being impacted and the systems currently in place to manage those systems and impacts – may not be well matched, particularly in the case of climate change, where impacts can be widespread and uncertainty is high. Theorists term this a problem of "fit" between impacts and actors (Moss & Newig, 2010; Pittman et al., 2015).

Local management of climate change impacts is often positioned under the umbrella of adaptation to climate change. Adaptation focuses on the resilience of systems – both ecological and social – to climate change disruptions. Adaptive approaches to management and governance at the local level seek to network existing institutions and include community voices and diverse actors in the decision-making process, aiming to ensure that outcomes are inclusive of diverse interests and priorities. The methods and effectiveness of inclusive decision-making varies across attempts, from passive calls for community feedback to the active recruitment of diverse stakeholders with diverse knowledge and perspectives. Collecting and incorporating the knowledge and perspectives of diverse stakeholders lacks a standardized methodology and functional integration into the definition of the problem and the boundary making around ecological and management scales.

Addressing climate change locally requires the bounding of the problem of climate change in a way that supports adaptive action and management. The impacts of climate change, to both social and ecological systems, may spill over designated borders and jurisdictions, and the impacts may vary in intensity based on the nuance of landscapes or existing systems health. Defining climate change in a manner that allows local actors to address local impacts requires setting boundaries and working towards a fit between impacts to be managed and institutions doing the managing. Established methods can be used to orchestrate this fit; ecological systems can be mapped and future impacts modeled to bind the ecological impacts, and an analysis of agency mandates, institutional jurisdictions, and vested interests compiled to map the management components. Overlaying these two maps – of impacted systems and existing management actors – can improve the "fit" of adaptive strategies addressing local climate change. However, without the inclusion of the beliefs and concerns of diverse stakeholders, the defined "fit" of the problem and actors involved may lack salience. Creating a third map, a map of the "meaning" of the problem as experienced by community stakeholders, can increase the community's recognition of the problem and support for adaptive solutions.

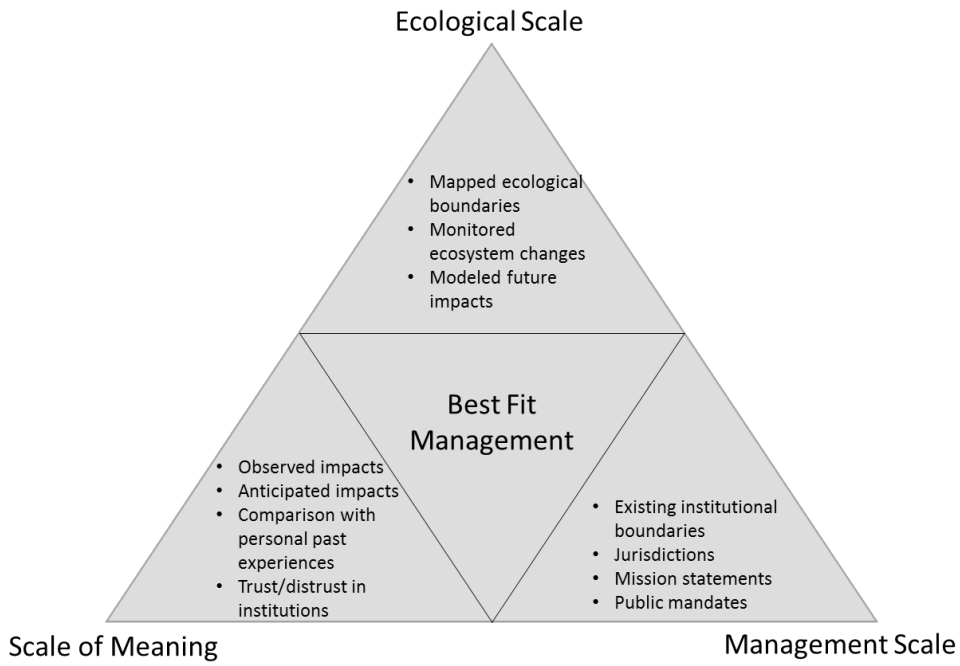

Figure 7 A tripartite model of fit

Meaning is made when individuals contextualize experiences and cognitive inputs within their belief systems and personal and community histories. This contextualization process embeds experiences within an individual's narrative. Narratives are built over time and serve to explain present conditions, motivate action, and predict future conditions. Investigating the narratives of environmental change in a community can illuminate contested areas, points of tension, and opportunities for motivation. Narrative analysis produces a map of the scale of meaning – how a problem like climate change is understood and experienced in a community – a map that can be laid over the maps of ecological and management boundaries to better fit the adaptive management approach to the local community. The tripartite mapping of climate change and corresponding management at a local level produces a definition of the

problem of local climate change that is meaningful to the community, reflective of the changes they are experiencing, and centers local concerns.

In their role as contextual framework, narratives help us interpret events. When what we experience or when we are presented with facts that run counter to our established narratives it is easier to reject those experiences or facts than it is to shift the established narrative. To shift narratives, to contextualize environmental changes as climate induced when that runs counter to an individual's established narrative, it is imperative to start at the point of "experience", and not the point of "fact". Tangible experiences produce powerful reactions in a way that static fact cannot. Building on concern for forest health or wildlife population decline, as experienced by the individual, can motivate more adaptive action, and position the individual to seek causal explanations more effectively than a building from a climate change model. What we believe is incredibly powerful – as demonstrated in the placebo effect and studies on the influence of visualization and positive thought – what we believe about the changes we observe dictates how we will respond to those changes.

Narrative analysis is useful in the problem definition phase as well as the management phase, especially when adaptive management approaches require the networking of diverse institutions and actors to fit the ecological and meaning scales of the problem. Climate change is a touchstone in the current political climate, with political and social identity deeply intertwined with views on the environment. Collecting narratives and using a visual process to present them provides stakeholders the opportunity to engage with their peers narratives without concern for

interpersonal conflict or fear of hostility. To effectively network actors and institutions together, the individuals involved need a nuanced understanding of the beliefs and values of the other actors at the table. Narrative, particularly visually depicted narrative, provides that nuance, and sharing narrative can help build bridges between actors where their interests align. It is easy to say “everyone thinks like I do” or “no one thinks like I do” if narratives are hidden, and on politically tense topics, narratives are often suppressed, and nuance lost to political rhetoric.

Natural resource dependent communities are particularly vulnerable to climate impacts to social-ecological systems. The North Shore of Minnesota is no exception, with impacts to forest health, wildlife and fish populations, and weather patterns currently being experienced. The North Shore of Minnesota relies heavily on the quality and accessibility of its natural resources for the tourism and outdoor recreation economy to flourish. As climate change continues, local impacts on the North Shore will become more pronounced. Local leaders are already noticing changes to the forests, streams, and wildlife and attributing those impacts to a changing climate. The challenge to confronting local impacts of climate change begins with the difficulties around defining the problem, specifically defining the spatial scale of the problem.

The North Shore currently lacks local government initiatives that work to address climate change and the scope of the problem has yet to be defined and institutionalized. This is both a challenge and an opportunity for the North Shore, as existing government boundaries are often insufficient to address climate change or other socio-ecological

system issues. The dependence of the entire North Shore community on the health and functioning of local natural resources makes limiting the management of climate change to a single town, county, or park both inefficient and unlikely to motivate individuals to act. The necessity of incorporating a diverse range of actors at multiple scales is further informed by adaptive governance theory which points to the need for new governance arrangements to be flexible, networked, and inclusive.

The process of collecting climate narratives on the North Shore began by engaging diverse actors, including in the definition of "decision maker" traditional actors – elected officials, natural resource managers – who represent institutional positions, and nontraditional actors – business owners, community activists – who represent civic positions. The individuals engaged by this research have already had the opportunity to have standing given to the meaning derived from their experiences. They have already drawn stronger connections with local climate change by providing their narratives to this project. Any future management effort on climate change will benefit from the internal connections reinforced in these individuals through the re-telling of their climate narrative.

In addition to priming participating individuals for future networked engagement, narrative analysis provides new ways to overcome the challenge of problem scoping and motivating adaptive action to confront climate change locally. The narrative visualization framework has a number of significant management implications. To begin, the blank framework itself provides a scaffolding of the themes emergent from the range of climate narratives present in the community. On the North

Shore, this thematic framework highlights the challenges of spatially and temporally scoping climate change. Viewing the populated individual narrative frameworks shows the range of beliefs about the spatial and temporal scale of the problem of climate change and the scale of response.

Narrative theory states that narratives are codified, legitimized, and transmitted at the level of institutions. However, because institutions on the North Shore are either not actively working on climate change, or are working at a scale not experienced by, or resonant to, other individuals, there is an opportunity to produce a narrative that specifically targets adaptation to climate change on the North Shore. The narrative visualization framework is designed to provide nuanced information on the range of narratives present in the community to allow willing actors to construct a resonant narrative of response to climate change.

Analysis of the series of individual narratives suggests that for the North Shore, the scale of the response needs to focus on local observable changes, which are described by even those who do not believe that climate change is happening locally. Any adaptation or management narrative that focuses on mitigation or impacts globally, will likely be met with resistance and uncertainty. As would a narrative overly reliant on future modeling or education on climate change. It is too easy to reject a non-contextualized fact that conflicts with an internal narrative than it is to shift that narrative. Focusing on observable changes offers a more promising avenue. A narrative that highlights impacts to local ecosystems, and steers clear of less tangible impacts, like temperature variability, will

be more likely to motivate locals to take action, support policies, and pay attention to further changes.

A group of community members – whether associated with formal institutions or not – looking to promote adaptation to climate change could construct an adaptation narrative touching on each of the themes in the narrative visualization tool and use that to inform goal setting, communication and outreach strategies, and further collection of local experiences that support the new narrative.

Additional insight can be gained through integrating the findings of this study with the larger multiphase, interdisciplinary project. The adaptive capacity assessment of North Shore decision makers found high levels of individual capacity, but low levels of organizational and leadership capacity. This shines additional light on the need for a collaborative group to lead on climate adaptation. Limited organizational capacity is a barrier to adaptation, but an opportunity for networks to form to fill the holes and narratives to be constructed anew, rather than revised from existing organizational narratives.

Furthermore, the models constructed as a part of this project offer highly localized modeling that can serve to reduce uncertainty among those for whom models can be contextualized into their narratives. Pairing the models with the local narratives can help prioritize actions and inform the construction of a management narrative. Specifically, linking observable changes in the models with what is being experienced in the

community can act as a contextual bridge between observational fact and scientific fact.

Future research

More research is needed in the natural resource sciences on what a conscious construction of a narrative would entail, and what effects it might have. There is great potential for future research on the topic and to further the reach of the project.

There are two avenues that would add validity and expand the reach of the narrative visualization framework and narrative analysis approach. First, to expand the generalizability of these findings on the North Shore and support the narrative visualization framework approach, a paired quantitative study design approach would be beneficial. Designing a survey for North Shore residents that includes metrics to measure elements of the themes in the visualization framework would provide additional, generalizable data around community based problem scoping. This would lend support to the relevance of those themes and add statistical validity for those that use a western science lens to contextualize facts into meaning. The addition of a quantitative component would expand the existing body of knowledge focused on North Shore climate impacts (Galatowitsch et al., 2009; Huff and Thomas, 2014; Lenarz et al., 2009) and the potential economic ramifications of changing North Shore landscapes. (Smith et al., 2016)

A further avenue for future research would be to conduct another qualitative study in a Great Lakes natural resource dependent community.

Starting with the existing narrative visualization framework, the study would investigate the relevance of the themes derived from the North Shore study for similarly situated communities. This would also be an opportunity to focus on streamlining the data collection and analysis process, rather than on the design of the tool itself. Qualitative methodologies have powerful implications for social-ecological systems research, providing context and information on how social, ecological, and economic systems interrelated in the face of change (Geisler et al., 2016). More research is needed to help close the knowledge gap in the way that ecological and social systems are understood (Halder et al., 2012). Further, refining the process of collecting and presenting narrative data in a format that is meaningful and accessible to managers and citizens can help close that gap.

Narrative theories application to governance problems has typically focused on placing individuals in categories of cultural alignment (Jones & Song, 2014) and understand local experience with change and meaning creation (Fartbotko & Lazrus, 2012; Jasanoff, 2010; Paschon & Ison, 2014; Veland & Lynch, 2017). Adding an additional layer of reflexive process, where in the narratives told inform the narratives created, pushes the narrative theory towards applied uses for motivation and problem framing.

As adaptive approaches to governance become increasingly localized to match the socio-ecological scale of environmental problems (Moss & Newig, 2010), research into the theory of narrative development and the potential of narratives to mobilize communities, should shift to a

similarly local focus. Research has shown that including diverse voices and validating local lived experiences of change, supports adaptation efforts (Granderson, 2014; Miller & Solin, 2015). Centering a collaborative, community based process of narrative formation democratizes narrative and supports the development of flexible and adaptive networks to address local socio-ecological problems. Studying the process and outcomes of purposeful, democratized construction of local problem definition and management narratives has much to offer the implementation of adaptive approaches to governance and localized adaptation. One of the challenges facing adaptive approaches is addressing the misfit between governance and social-ecological systems; a challenge confronted by taking an inclusive, adaptive approach to problem formation (Moss & Newig, 2010; Pittman et al., 2015).

Theories of adaptive governance point to the importance of localized trusted information and strong community support to confront complex environmental problems. (Dietz et al., 2003). To effectively support inclusivity in the governance process, local expertise and personal experiences need to be incorporated into the management process (Boyd & Folke, 2012; Chaffin et al., 2014; Paschen & Ison, 2014; Wyborn, 2015). Narrative methods of data collection and problem definition offer the opportunity to both actively engage community members from the beginning, validate local experiences, and through analysis, work to construct a narrative of management that is motivating for community members. Studying the conscious construction of a management narrative as a way to motivate action and begin the process of adapting to climate change combines adaptive governance and narrative theories to approach

complex problems from a community centric position. This research could either be passive through observing emergent narrative construction, or could begin by designing a process for managers to follow in order to construct a management narrative and then following the effectiveness and outcomes over time.

There is certainly a need to better understand community perceptions of climate change, and to figure out what narratives of response to climate change impacts will motivate behavior change and policy support. Climate change is an issue that requires action from all people at all levels of society. Figuring out how to target areas of personal concern and motivate through activating individual narratives is critical to moving local communities towards adaptive and resilient futures.

Conclusion

This study suggests that validating local voices and experiences, and focusing narratives of management on local, observable changes to natural resources will support adaptive action by the local community. Findings indicate that there is no singular narrative of climate change on the North Shore, instead the community possesses a range of narratives focusing on different spatial and temporal scales of problem and management response. Narrative theory suggests that these personal narratives will resist facts and experiences that do not support the narrative structure. Additionally, narrative theory posits that each narrative exists to the exclusion of all others. To combat these challenges to motivating adaptive change, a collaboratively constructed narrative that draws from the range of existing narratives is a promising starting point.

Collaboration provides a range of perspectives, and a focus on management supports the codification and replication of the narrative through transmission by existing institutions.

The narrative visualization tool is designed to be accessible to the collaborative parties seeking support for adaptive planning on the North Shore. The thematic break down and representation of individual narratives serves to provide a quick snapshot and rely on little additional analysis by the end user. It is the aim of this study to provide insight into community perceptions and foster adaptive action to confront climate change on the North Shore. Local application of the information visualized in the narrative framework offers both insight and starting point, for managers looking to communicate about climate change and those seeking a new narrative of adaptive management on the North Shore.

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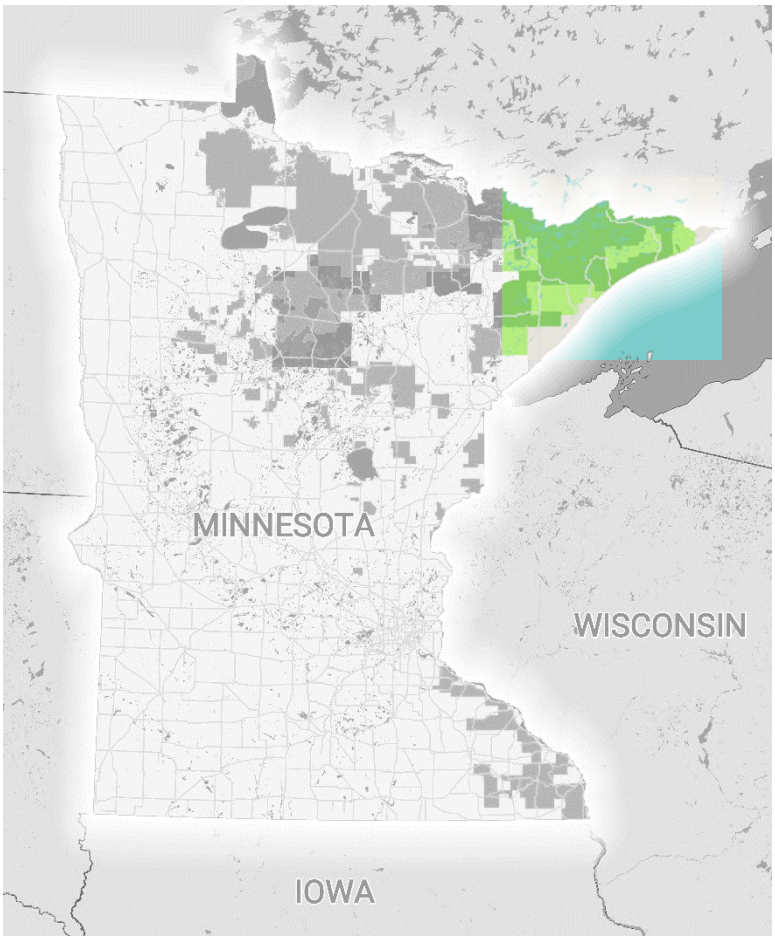
Appendices

Appendix A: Study Area

The North Shore study area is defined by the North and South Superior watershed boundaries, which includes parts of two counties – Lake and Cook County – as well as 189 miles of Lake Superior shoreline.



Appendix B: Contact Script

Coastal Community Readiness on the North Shore
Interview Recruitment Script
Updated 10/3/14

Hello, my name is ___. I am [*position*] conducting research _____ for Mae Davenport, Associate Professor in the Department of Forest Resources at the University of Minnesota. This study is aimed at better understanding recreation and tourism resources on the North Shore and building climate readiness. We are working with local residents, leaders and natural resource professionals in the area to get input and guidance on this study. We are also conducting interviews with local experts in the community. These interviews will help us identify important community assets and needs, and climate-related impacts to recreation and tourism resources.

I am hoping you would be able to assist me by participating in an interview and sharing your perspectives with me. Would you be willing to participate?
If yes: "Thank you. I will be on the North Shore on _____ (*dates, days of week, times, have alternates ready*) is there a day/time that would work best for you? Where would you like to meet? [*Set date, time, location (get directions)*]. I would like to send you a confirmation email. The email will include my contact information, in case you have any questions or concerns. Do you have an email address I can send the confirmation to?

a. **If yes**, take it down or confirm we have the correct email address for them. "Thank you. I look forward to meeting with you on ___(*agreed upon date*)___."

b. **If no**, "Is __(*phone # you contact them with*)___ the best way for me to get a hold of you? In case you need to get a hold of me with questions or concerns, my phone number is _____." I look forward to meeting with you on ___(*agreed upon date*)___.

If no: "Ok, thank you for your time. For research purposes, can I ask why you wish not to participate? [*write this down*]. Okay, thank you. Good bye."

If they seem unsure: “Just to be clear, your participation is completely voluntary and you can withdraw at any time. Your identity will remain confidential and we won’t include any information that would make it possible to identify you in any public documents. We’re only talking to a limited number of key representatives, so capturing your perspective is important. Can I ask what you concerns about participating are?” [*Try to address their concerns*]

If they want to know why they are being asked to participate: “We’re interviewing a variety of stakeholders to gather diverse perspectives and a range of experiences in the North Shore community. You were identified as community member who may be able to share some valuable insight with us on this topic. Since we are only able to conduct a limited number of interviews, capturing your perspective is important.”

If they want to know how the information will be used: Your personal information will be kept confidential and there will not be any identifying information in any publications.”

If they want to know more background: This project is funded by Minnesota Sea Grant. MN Sea Grant has identified “resilient communities and economies” and “hazard preparedness” as areas for communities to strengthen in order to adapt to future climate related impacts to the tourist dependent community. Our projects will address the current capacity of these areas and develop a plan for the future. We will be providing decision support tools for recreation and tourism professionals on the North Shore to help build climate readiness.

If they want to know who is supervising the research: “Mae Davenport is the supervisor for this study. She is an associate professor in the Department of Forest Resources at the U of M. If you would like to contact her directly I can give you her phone number [612-624-2721] or email address [mdaven@umn.edu].”

Appendix C: Consent Form

Building Climate Readiness in Nature-Based Tourism-Dependent Coastal Communities

Consent Form

You are invited to participate in a research study that explores community readiness to respond to impacts of climate change on the North Shore. You were selected as a possible participant for an interview because you are currently living or working in the North Shore area. We ask that you read this form and ask any questions you may have before agreeing to be in the study. This study is being conducted by: Mae Davenport, Associate Professor at Department of Forest Resources, University of Minnesota.

Background Information
The purpose of this study is to better understand what impacts climate change will have on the nature-based tourism economy along the North Shore. The study also aims to identify the tools and resources available for the community to respond to these changes; and make recommendations to further prepare for potential future scenarios.

Procedures:
If you agree to be in this study, we would ask you to do the following thing: Participate in an interview, lasting approximately 60 minutes. The interview will be audio recorded and transcribed.

Risks and Benefits of being in the Study
Risks associated with this study are minimal, responses are confidential and names will not be linked to any information in any publications. Benefits of participation include increased awareness of resources and tools in place to adapt to impacts of climate change. Study results will be made available to the public and all participants will have access to them.

Confidentiality:
The records of this study will be kept private. In any sort of report we might publish, we will not include any information that will make it possible to identify a subject. Research records will be stored securely and only researchers will have access to the records. Your responses to the interview questions will be audio recorded, transcribed and kept for three

years in a locked office. Afterward, these tapes will be destroyed. Only those directly involved with the project will have access to the audio tape of the interview notes.

Voluntary Nature of the Study:
Participation in this study is voluntary. Your decision whether or not to participate will not affect your current or future relations with the University of Minnesota. If you decide to participate, you are free to not answer any question or withdraw at any time without affecting those relationships.

Contacts and Questions:
The researcher conducting this study is: Mae Davenport. You may ask any questions you have now. If you have questions later, **you are encouraged** to contact her at address: 115 Green Hall 1530 Cleveland Ave. North, St. Paul, MN 55108-6112, phone: 612-624-2721, email: mdaven@umn.edu.

If you have any questions or concerns regarding this study and would like to talk to someone other than the researcher, **you are encouraged** to contact the Research Subjects' Advocate Line, D528 Mayo, 420 Delaware St. Southeast, Minneapolis, Minnesota 55455; (612) 625-1650.
You will be given a copy of this information to keep for your records.

Statement of Consent:
I have read the above information. I have asked questions and have received answers. I consent to participate in the study.

"I agree_____ I disagree_____ to have my responses audio recorded"

"I agree_____ I disagree_____ that Mae Davenport may quote me anonymously in her papers"

Signature:_____D
ate: _____

Signature of
Investigator:_____Date: ___

Appendix D: Background Information Questionnaire

ID#: _____ Date: _____

North Shore Coastal Climate Readiness Assessment

Participant Demographic Information

Age:

Highest level of formal education:

Years lived in community:

Occupation:

Gender:

Race/Ethnicity:

Community groups/organizations/agency:

Appendix E: Interview Guide

CCR Interview Guide
Updated July 22 (pm), 2014

In our study we are interested in perspectives on community assets; changes to natural, recreation and tourism resources; as well as community responses to these changes. Our study communities include Grand Marais, Lutsen, and Finland. We are also interested in the "North Shore" as a community. What community would you say you are most familiar with? _____

1. How would you describe your connection to this community?
    a. Could you describe for me some of your work responsibilities or activities in the community?

First, I have a few questions about the community's assets.

2. What are some of the best things about the [North Shore, Grand Marais, Lutsen, Finland] community?
3. What draws people to visit the community?
4. What makes this community unique from other communities in the area?
    a. How would you describe the community to someone who has never been here before?
5. How important are natural resources and the environment to…
    a. Recreation and tourism in the area? Please explain.
    b. Area residents' quality of life? Please explain.
    c. The local economy? Please explain.

Next, I'd like to ask some specific questions about natural resources and the environment in the community. For clarity, I'll just generally refer to "natural resources" but that may include all aspects of the natural environment including water.

6. Have there been any significant changes or impacts to natural resources on the North Shore in the past 5 years? Please explain.
    a. What were the effects of these changes on the community?
7. Are you concerned about future changes or natural resource impacts? Please explain.
8. Some people we have talked to in the community are concerned specifically about climate-change and related natural resource impacts. What are your perspectives on this issue?

Now, I'd like to ask some questions about nature-based recreation and tourism in the community. I will use the term "recreation and tourism resources" as a general term to include experiences visitors have, as well as facilities, services, and industries across the private and public sectors.

9. Have there been any significant changes or impacts to recreation and tourism resources on the North Shore in the past 5 years? Please explain.
    a. What were the effects of these changes on the community?
10. Are you concerned about future changes or impacts to recreation and tourism resources? Please explain.
11. Some people we have talked to in the community are concerned specifically about climate-change and related impacts to recreation and tourism resources. What are your perspectives on this issue?

Now, I have a few questions about your community's responses to problems.

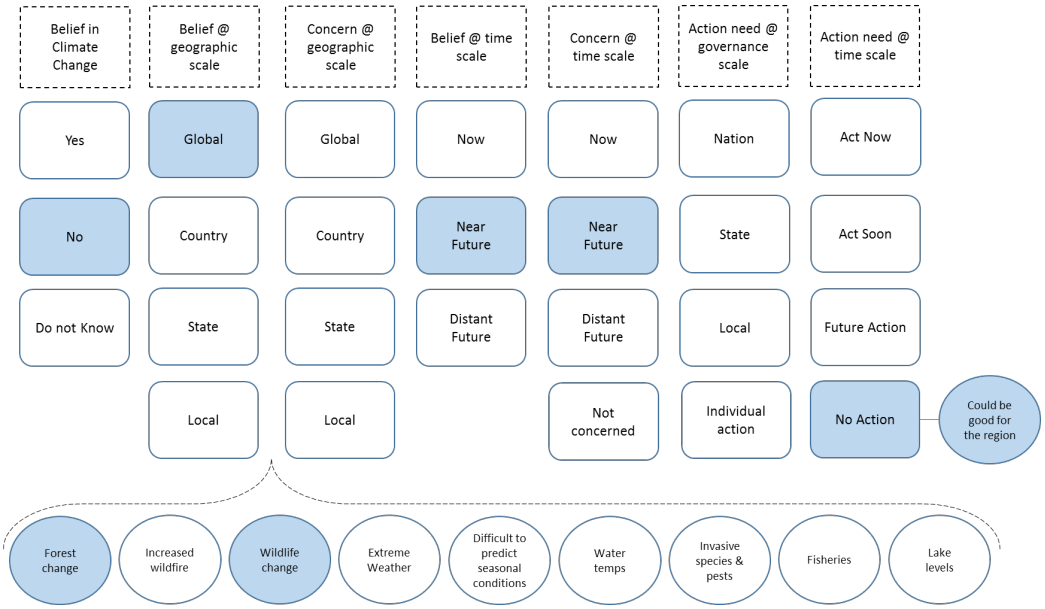
12. Who is most likely to get involved in natural resource issues in the community?
    a. Are individual community members actively engaged in natural resource issues? Please explain.
    b. Are business owners actively engaged in natural resource issues? Please explain.
    c. Are local community groups actively engaged in natural resource issues? Please explain.
    d. Are local government entities actively engaged in natural resource issues? Please explain.
    e. Are non-profit organizations actively engaged in natural resource issues? Please explain.

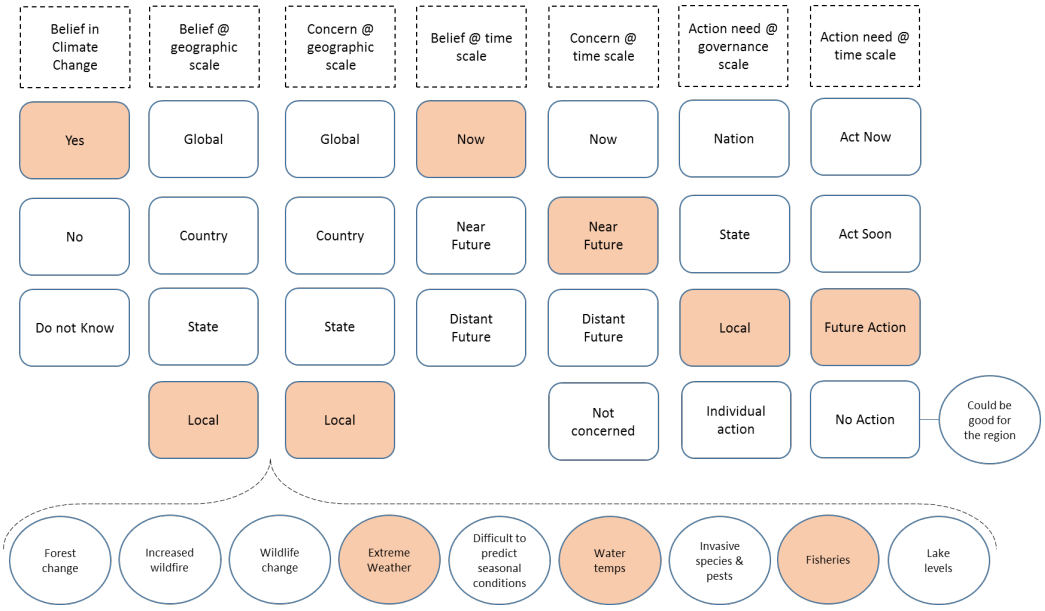
13. What types of resources do these groups bring to address the problem?
14. Are there other individuals, groups, resources or approaches that are needed?
15. Who is most likely to get involved in recreation and tourism resource issues in the community?
    a. Are individual community members actively engaged in recreation and tourism resource issues? Please explain.
    b. Are local community groups actively engaged in recreation and tourism resource issues? Please explain.
    c. Are local government entities actively engaged in recreation and tourism resource issues? Please explain.
    d. Are non-profit organizations actively engaged in recreation and tourism resource issues? Please explain.
16. What types of resources do these groups bring to address the problem?
17. Are there other individuals, groups, resources or approaches that are needed?

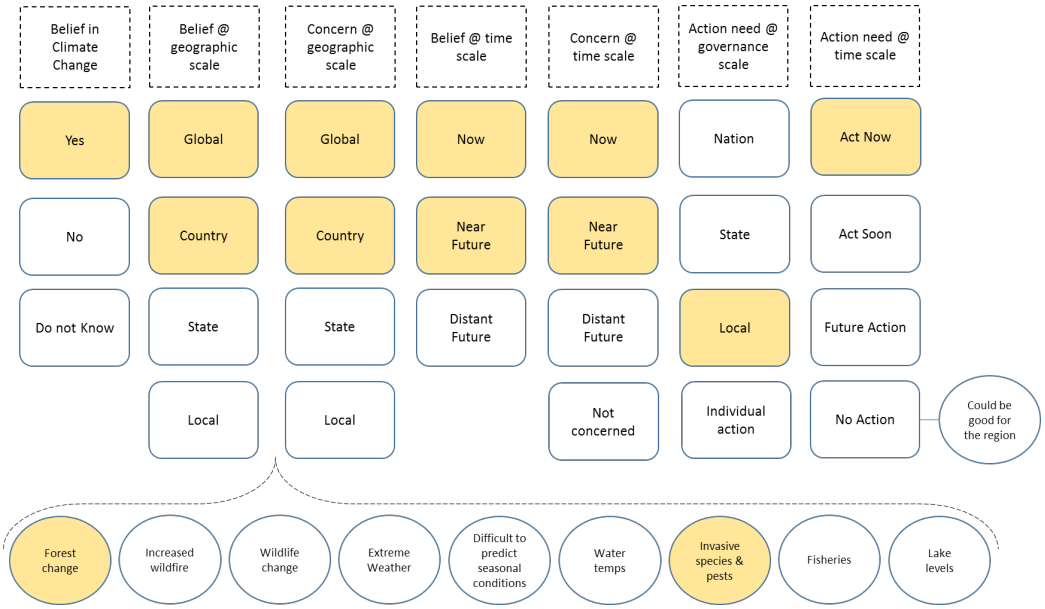
Finally, I have just a few closing questions

18. To sustain those community assets you described earlier into the future, what do you believe should be the biggest priorities of decision makers and managers in the community?
19. Is there anything else you'd like to add about your community or its natural and recreation/tourism resources?
20. Who else should we talk to?
    a. Who has a different perspective to offer?

Appendix F: North Shore Narrative Visualizations



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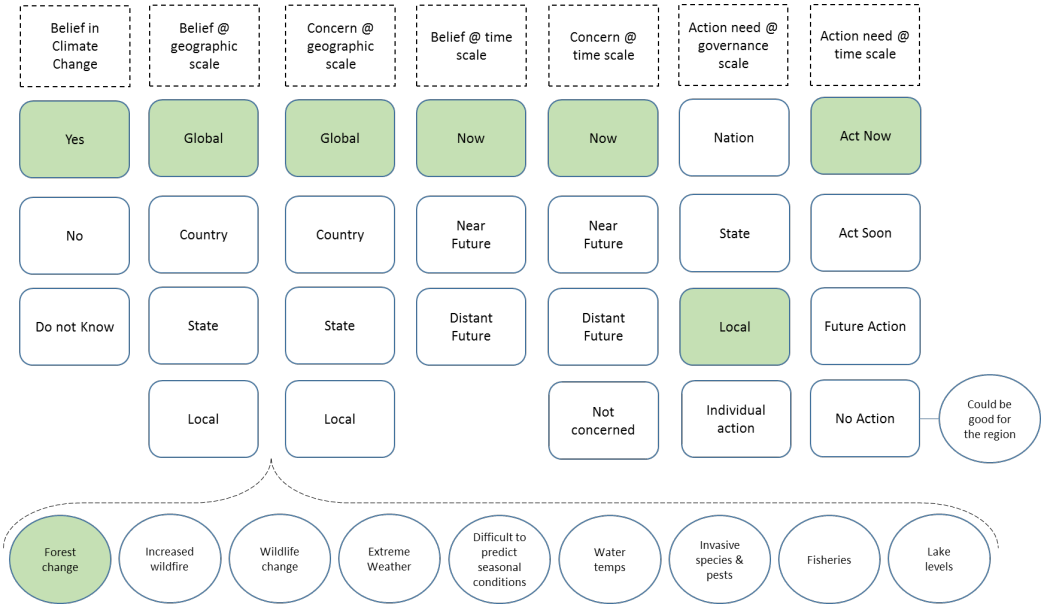
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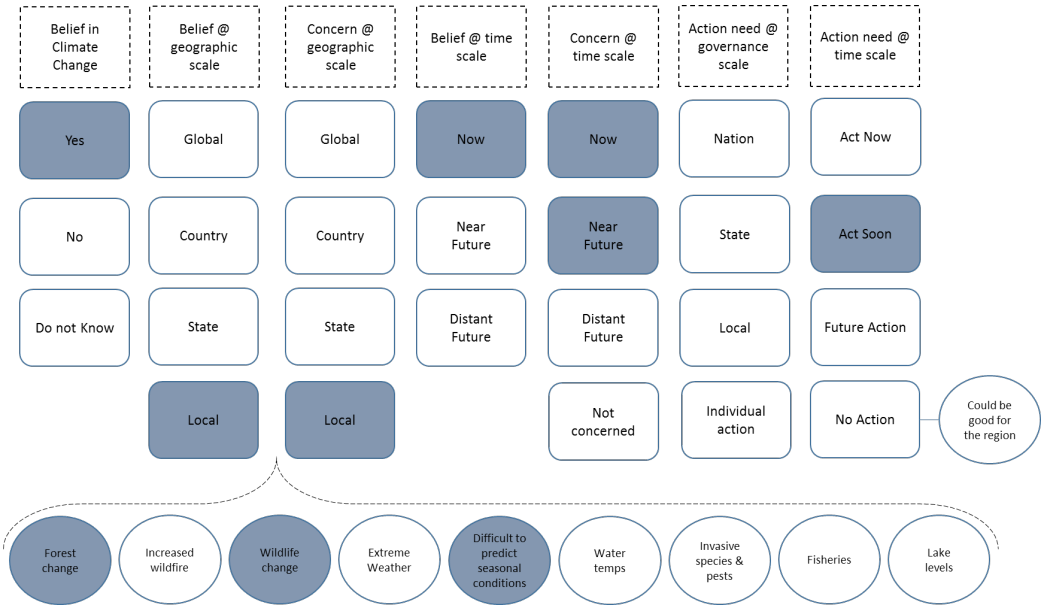
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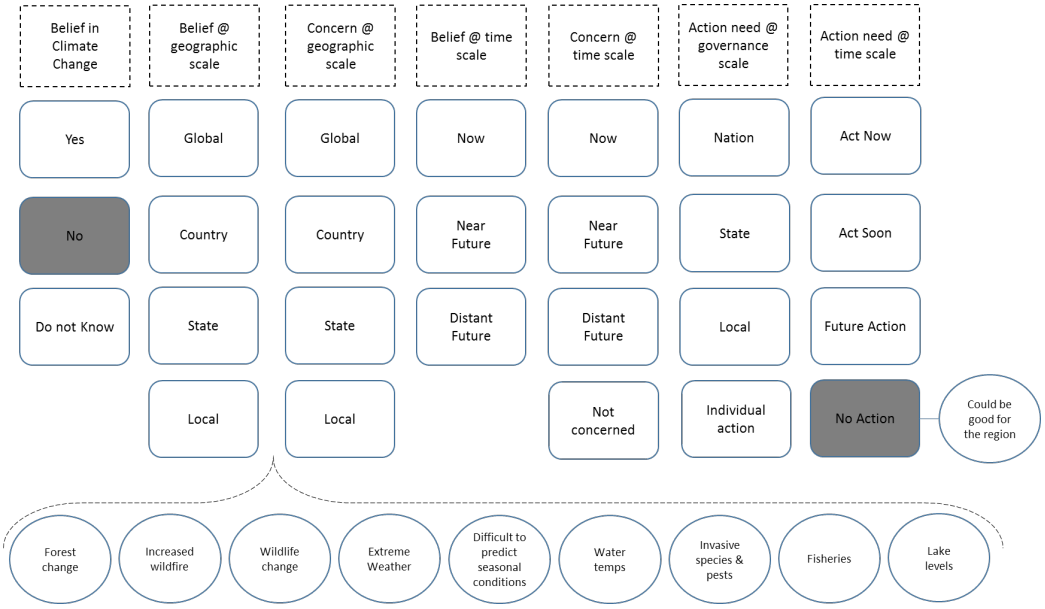
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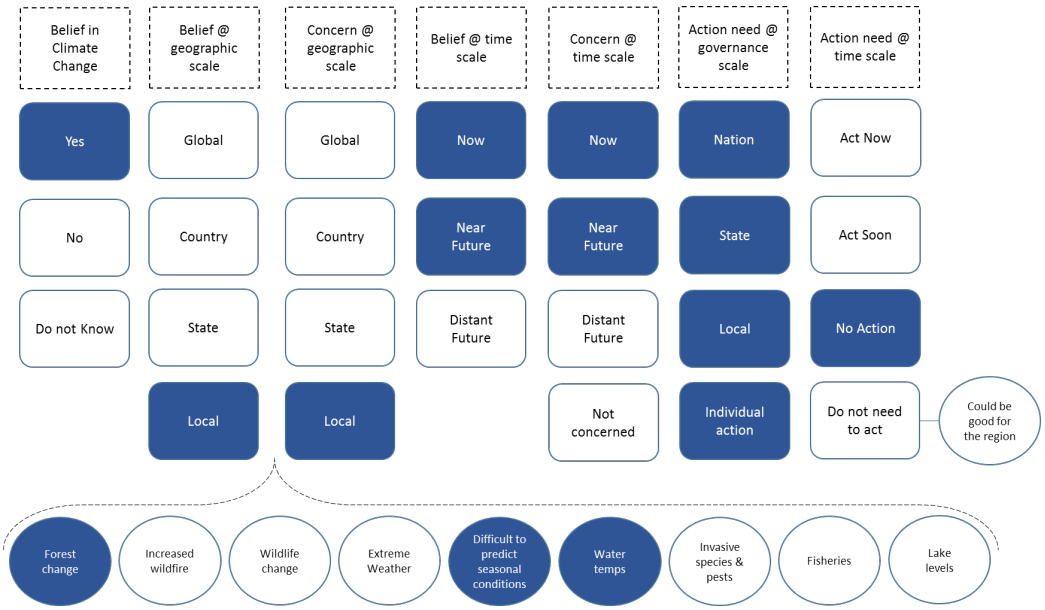
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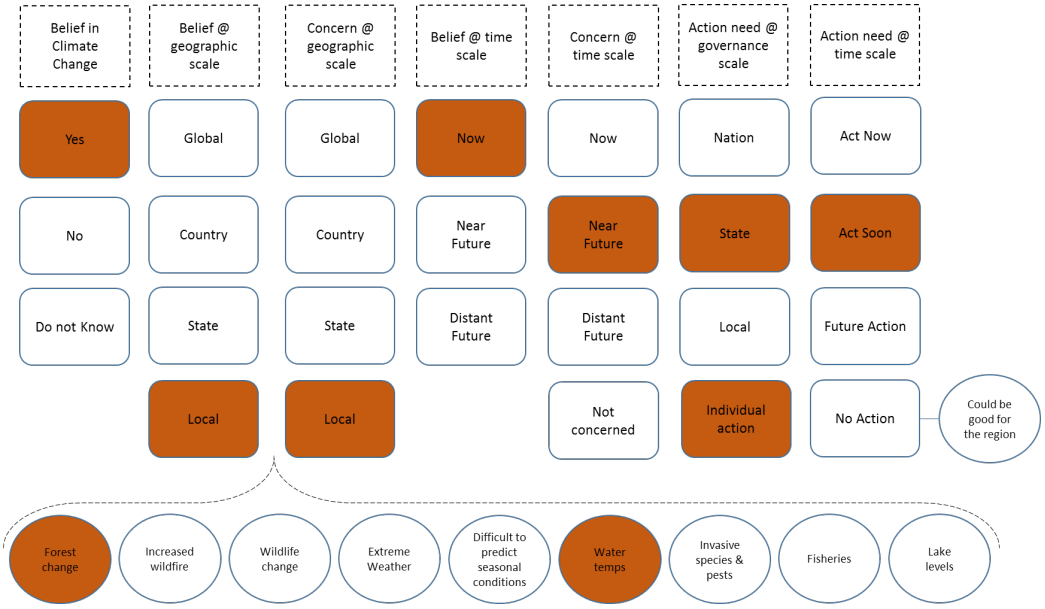
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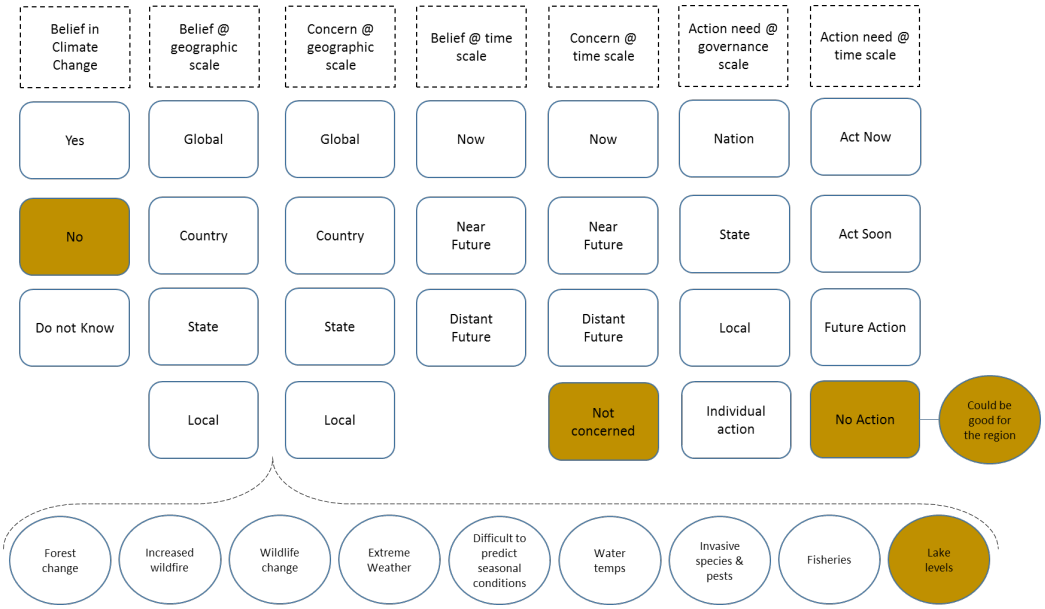
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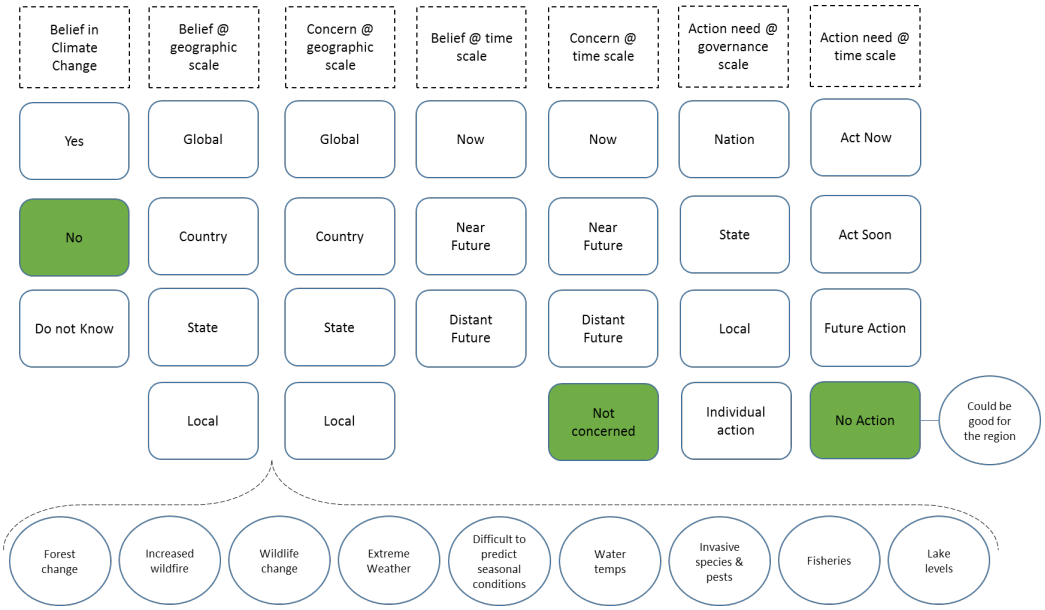
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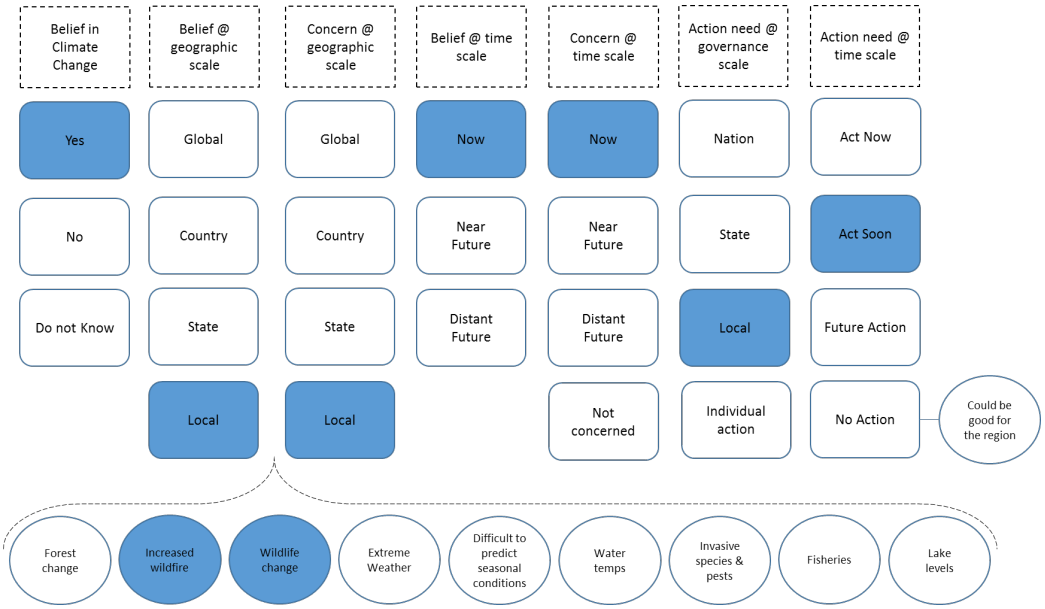
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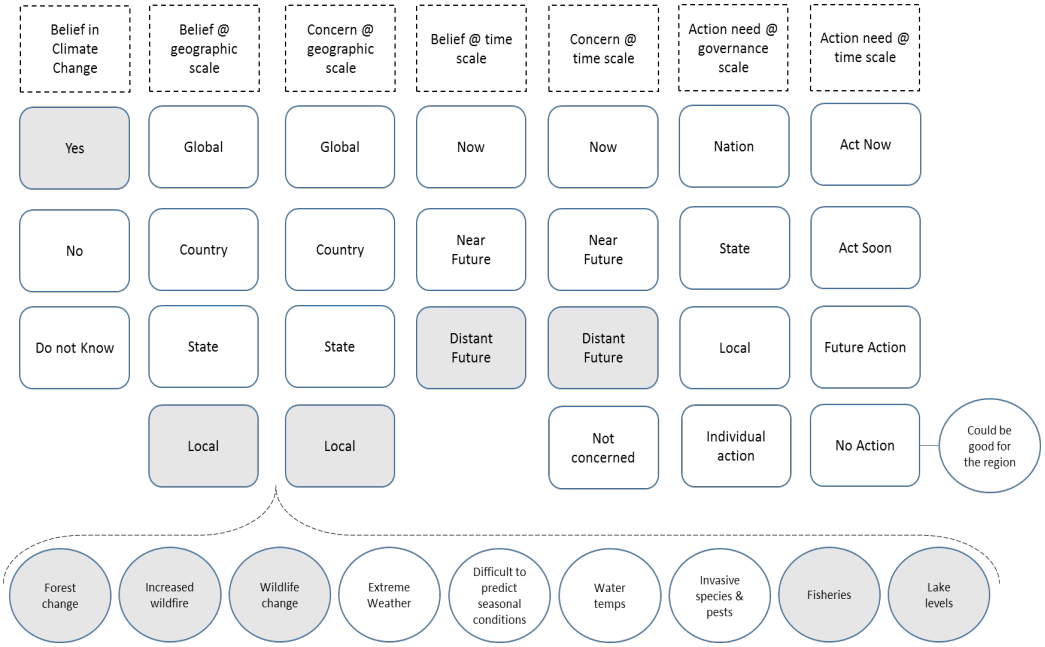
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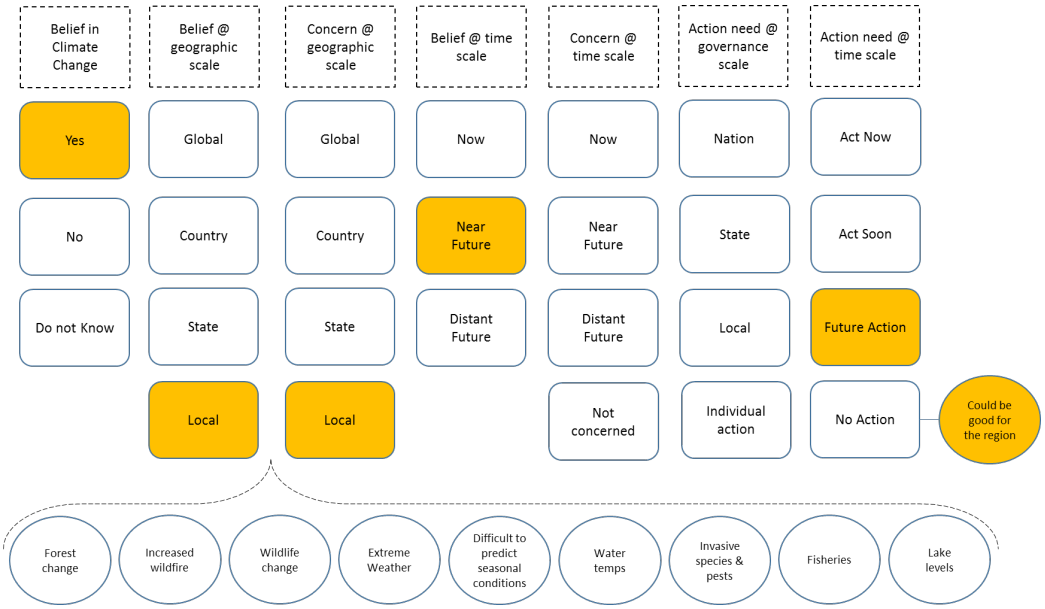
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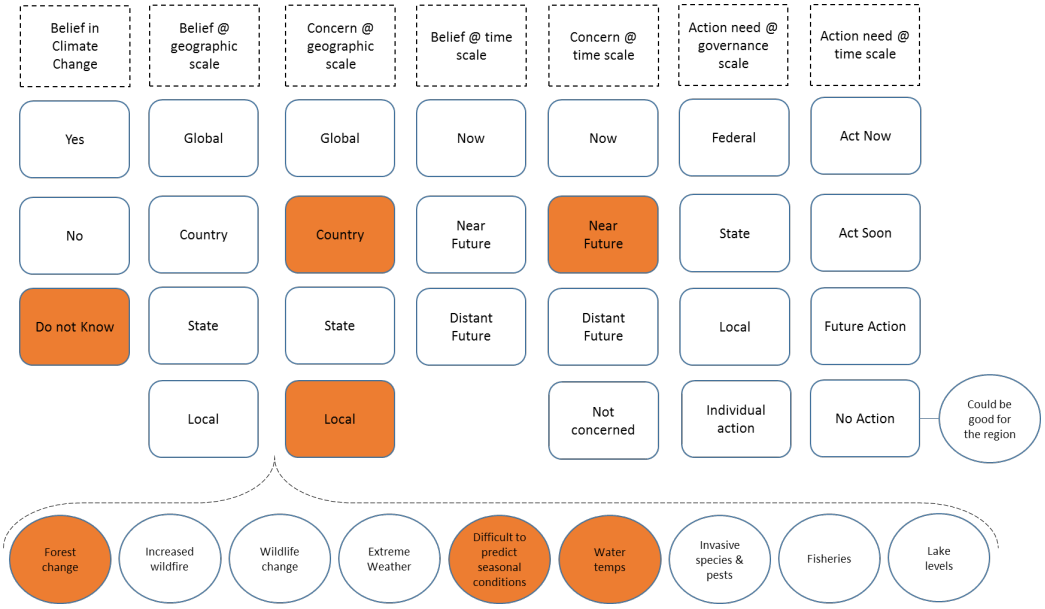
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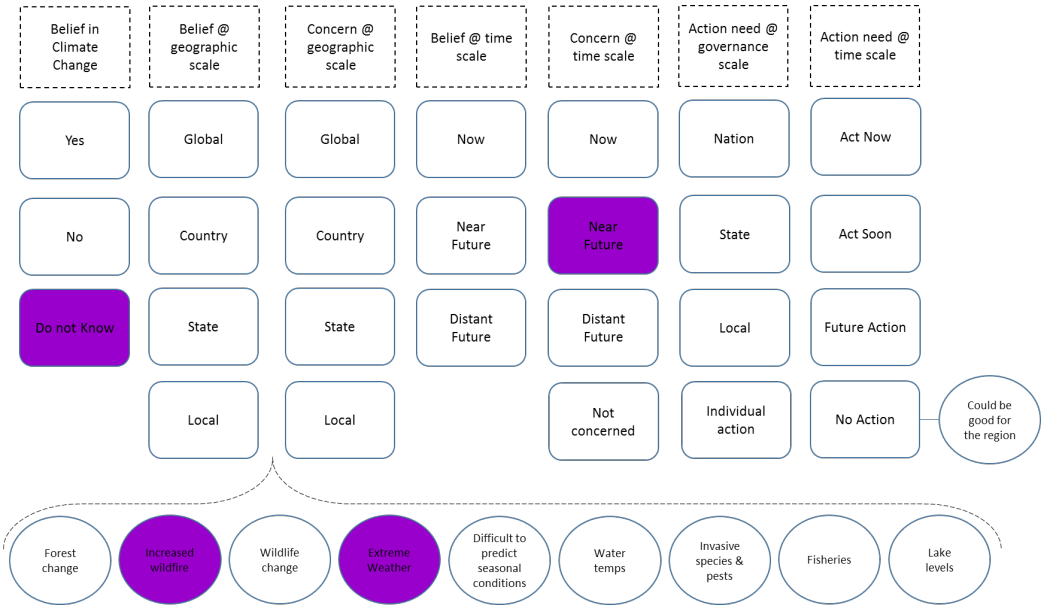
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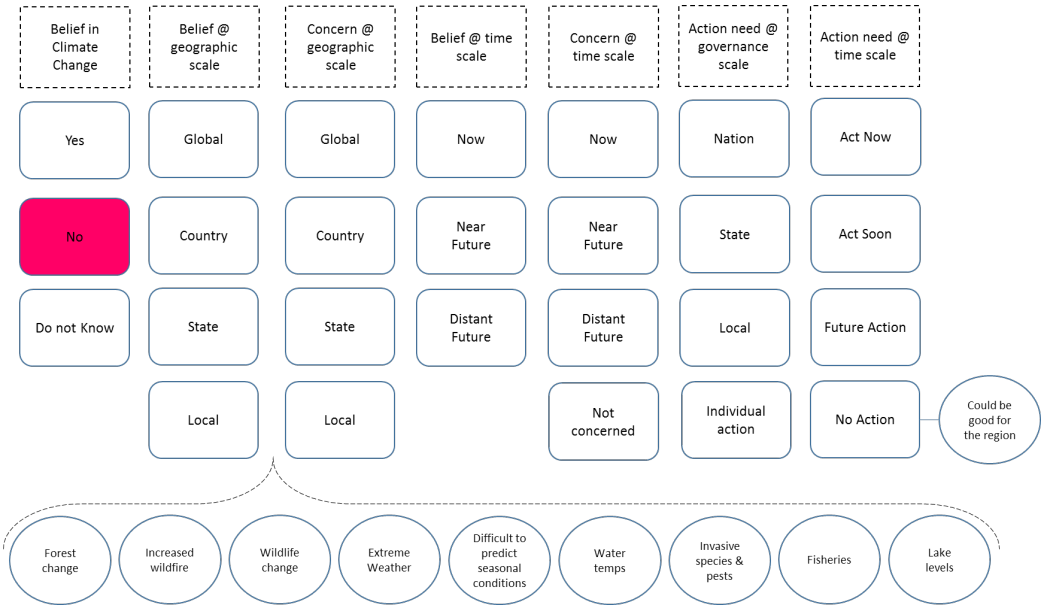
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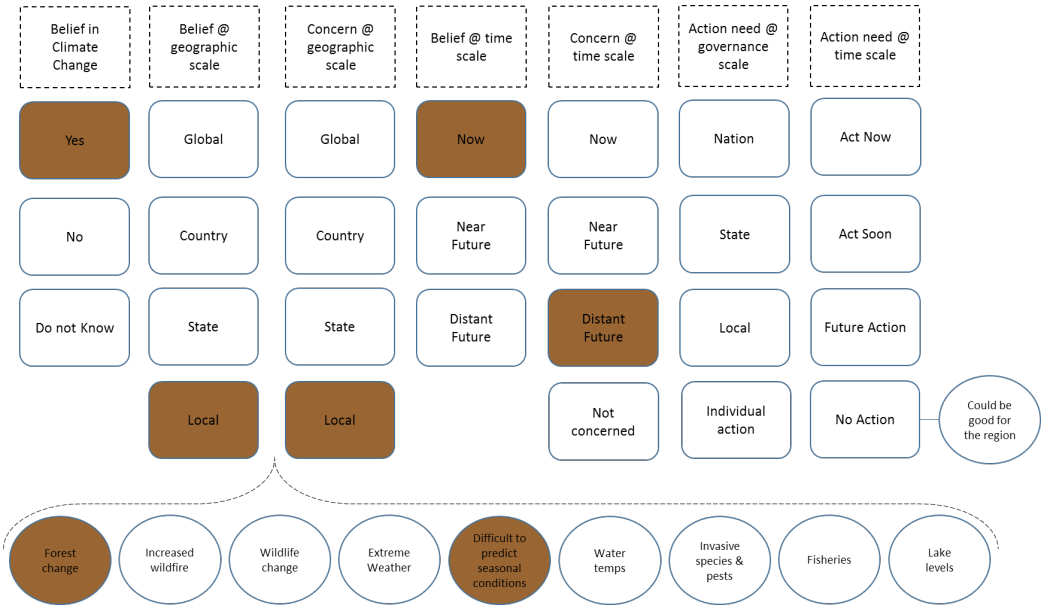
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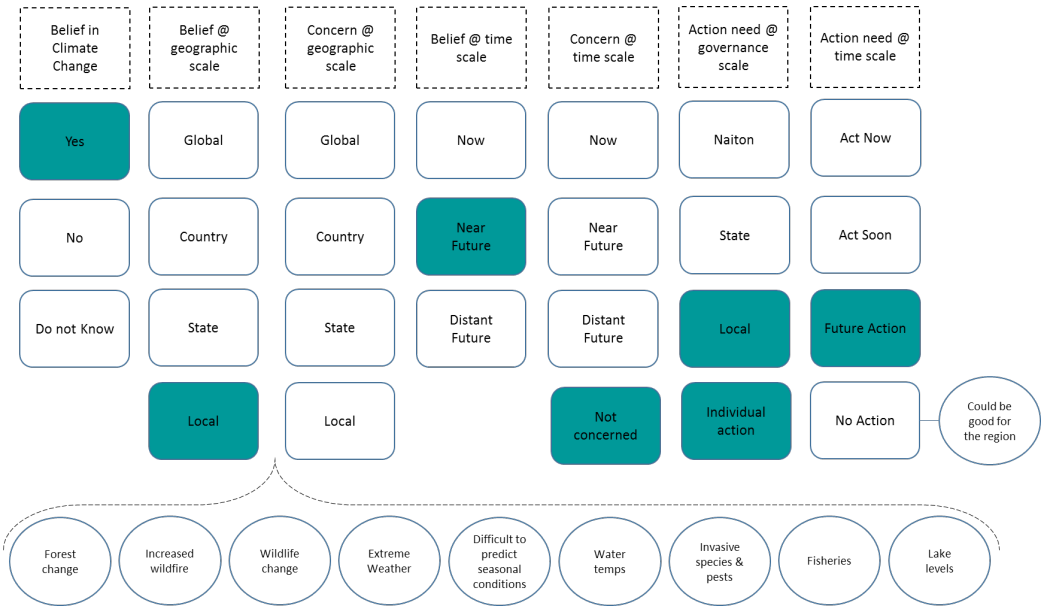
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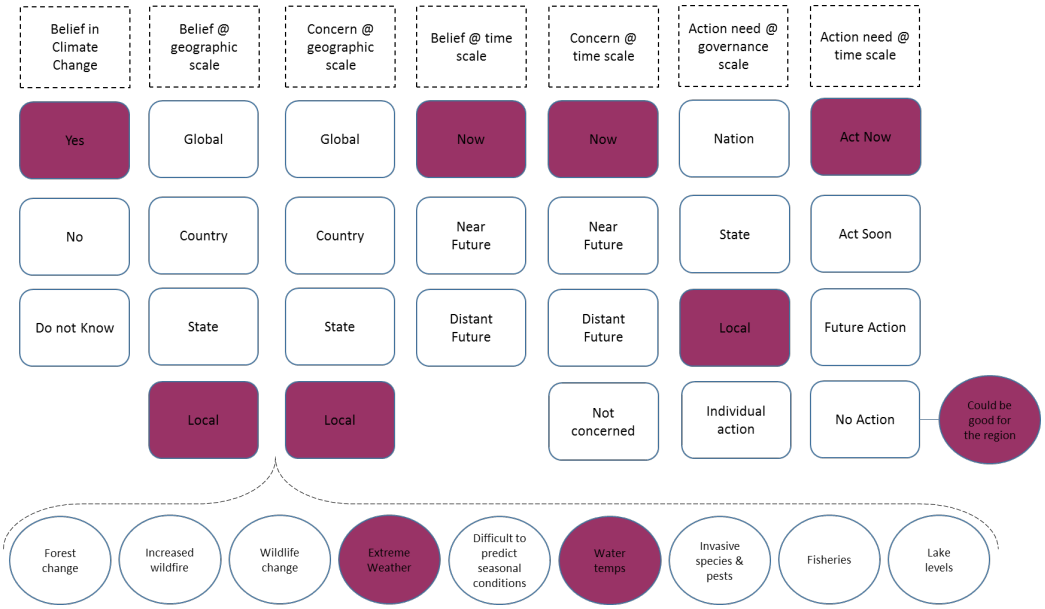
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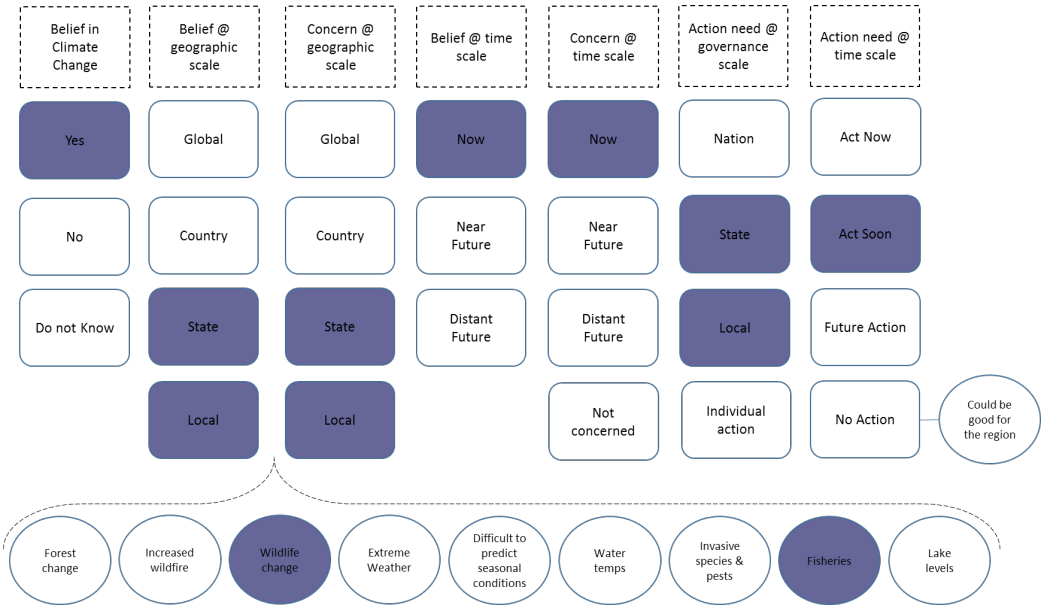
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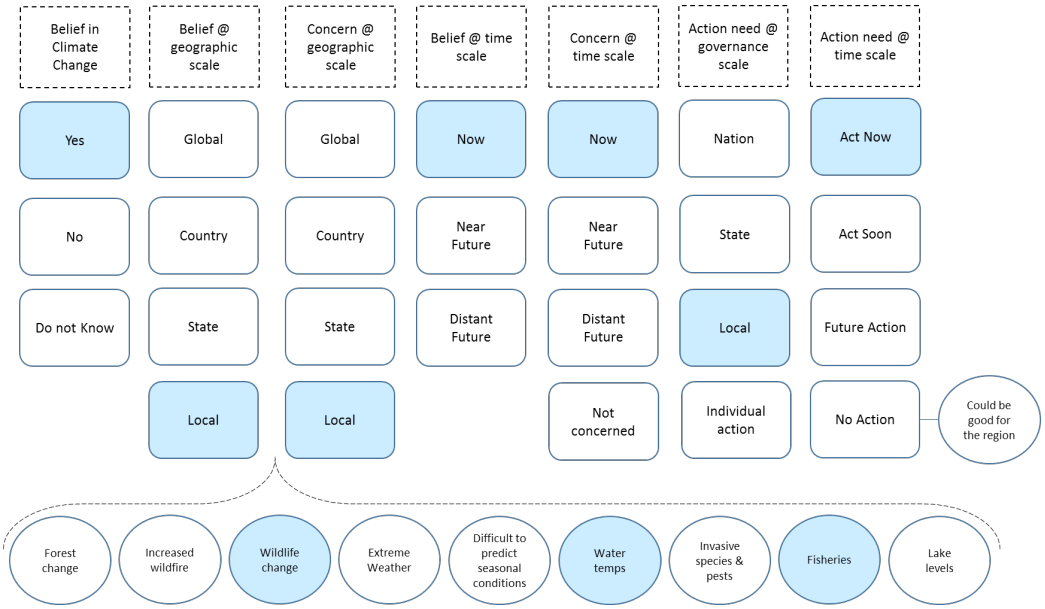
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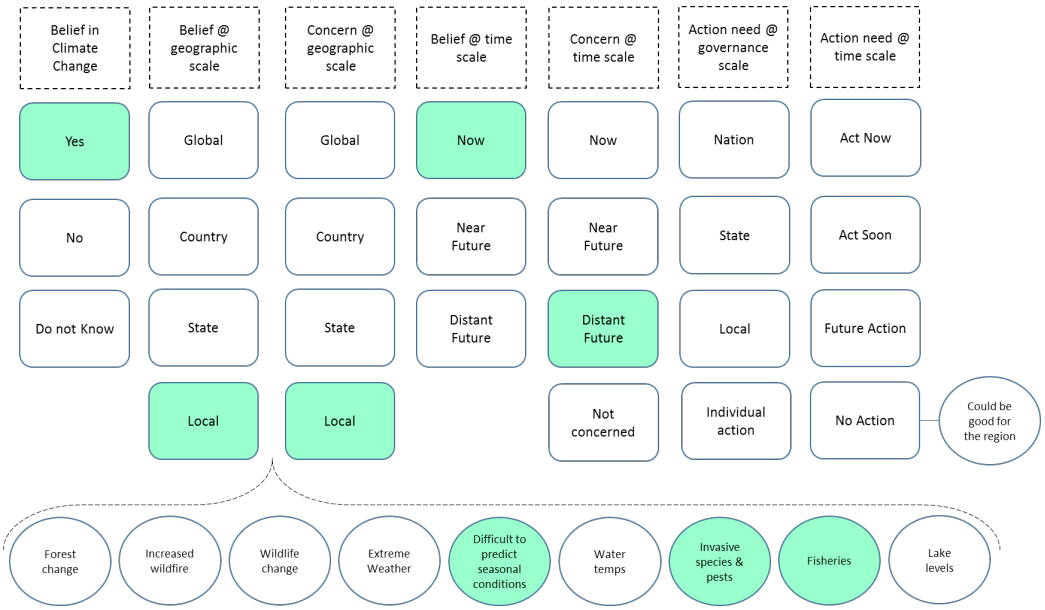
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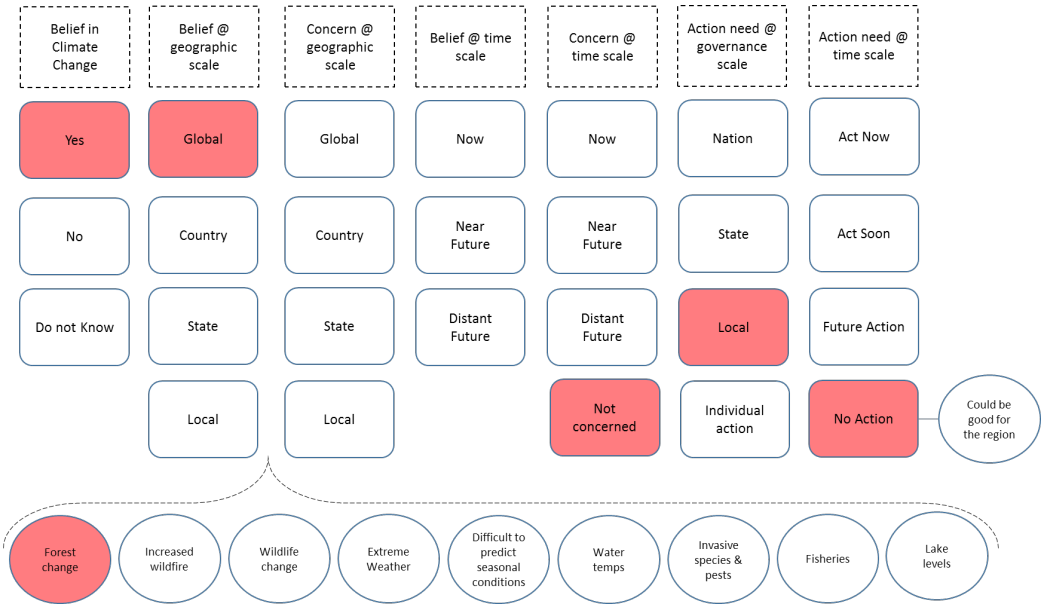
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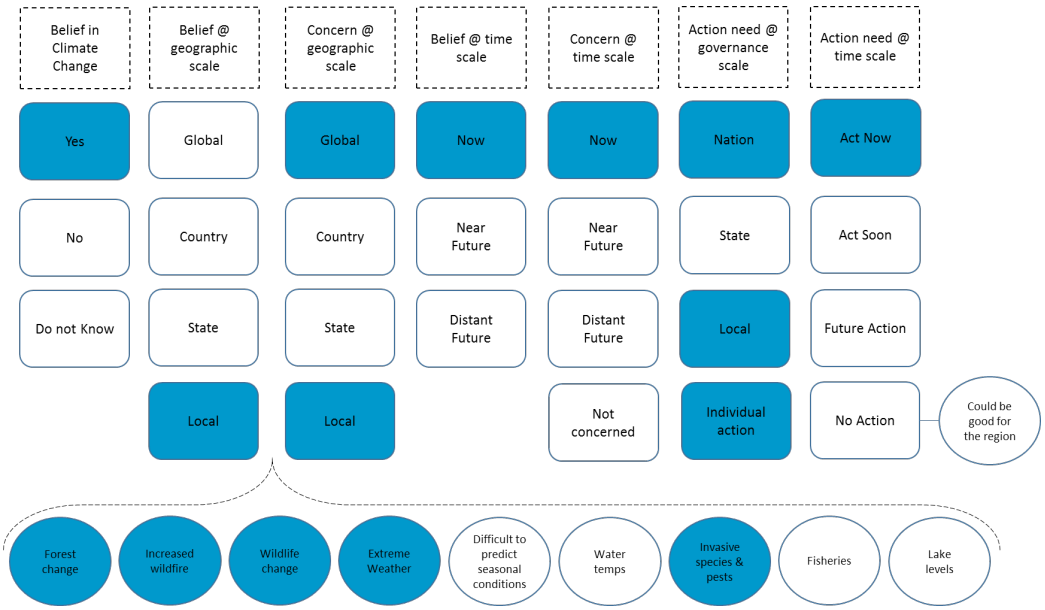
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